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ABSTRACT

The dual purpose of this module is to introduce students (grades 10-11) to current/emerging environmental issues and to emphasize the moral/ethical decision-making related to these issues. The module is organized into 12 topic areas, each containing a dilemma story, introductory reading material, sample student responses, and questions. Dilemmas are essentially brief stories which pose a critical decision to be made by a main character. This decision revolves around conflicts between two or more moral/ethical issues (as identified by Kohlberg) presented in the situation, and it is the moral/ethical implication that provides the thrust for student discussions. Preceding each dilemma are relevant readings or case studies providing basic background information regarding the environmental issue presented in the dilemma. Questions and sample student responses (representing positions taken by typical students) serve to stimulate thinking about the issues and generate discussions. Issues examined include water shortage; world food supply; protecting access to sunlight for solar heating/power purposes; microwave; nuclear power; coal; DDT (an insecticide); waste disposal/hazardous chemicals; polyvinyl chloride (PVC) and hazardous materials; wastewater treatment; and overproduction. The module may be used as a separate unit of study, mini-course, or incorporated into civics, history, biology, chemistry, environmental science and earth science courses. (JN)

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PREPARING FOR TOMORROW'S WORLD

ENVIRONMENTAL DILEMMAS:
Critical Decisions for Society

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PREPARING FOR TOMORROW'S WORLD

Environmental Dilemmas: Critical Decisions for Society

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PREFACE

We live in an exciting, rapidly changing, and challenging world—a world highly dependent upon science and technology. Our world is changing so rapidly that we sometimes fail to recognize that much of what we today take for granted as common, everyday occurrences existed only in the imaginations of people just a few short years ago. Advances in science and technology have brought many dreams to fruition. Long before today's school children become senior citizens, much of today's "science fiction" will, in fact, become reality. Recall just a few accomplishments which not long ago were viewed as idle dreams:

- *New biomedical advances have made it possible to replace defective hearts, kidneys and other organs.*
- *The first air flight at Kitty Hawk lasted only a few seconds. Now, a little over half a century later space ships travel thousands of miles an hour to explore distant planets.*
- *Nuclear technology—of interest a few short years ago because of its destructive potential—could provide humankind with almost limitless supplies of energy for peace-time needs.*
- *Computer technology has made it possible to solve in seconds problems which only a decade ago would require many human lifetimes.*
- *Science and technology have brought us to the brink of controlling weather, earthquakes and other natural phenomena.*

Moreover, the changes which we have been experiencing and to which we have become accustomed are occurring at an increasingly rapid rate. Changes, most futurists forecast, will continue and, in fact, even accelerate as we move into the 21st Century and beyond. But, as Barry Commoner has stated, "There is no such thing as a free lunch." These great advances will not be achieved without a high price. We are now beginning to experience the adverse effects of our great achievements:

- *The world's natural resources are being rapidly depleted.*
- *Our planet's water and air are no longer pure and clean.*
- *Thousands of plant and animal species are threatened with extinction.*
- *Nearly half the world's population suffers from malnutrition.*

While science and technology have given us tremendous power, we are also confronted with an awesome responsibility: to use the power and ability wisely, to make equitable decision tradeoffs, and to make valid and just choices when there is no absolute "right" alternative. Whether we have used our new powers wisely is highly questionable.

Today's youth will soon become society's decision-makers. Will they be capable of improving upon the decision-making of the past? Will they possess the skills and abilities to make effective, equitable, long-range decisions to create a better world?

To the student:

This module has been prepared to help you—the student and future decision maker—function more effectively in a rapidly changing world. Other modules in the *Preparing for Tomorrow's World* program focus on additional issues of current and future importance.

To the teacher:

It is our belief that this module—and indeed the entire *Preparing for Tomorrow's World* program—will help you the teacher prepare the future decision-maker to deal effectively with issues and challenges at the interfaces of science/technology/society. It is our belief that the contents and activities in this program will begin to prepare today's youth to live life to the fullest, in balance with Earth's resources and environmental limits, and to meet the challenges of tomorrow's world.

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Environmental Dilemmas: Critical Decisions for Society

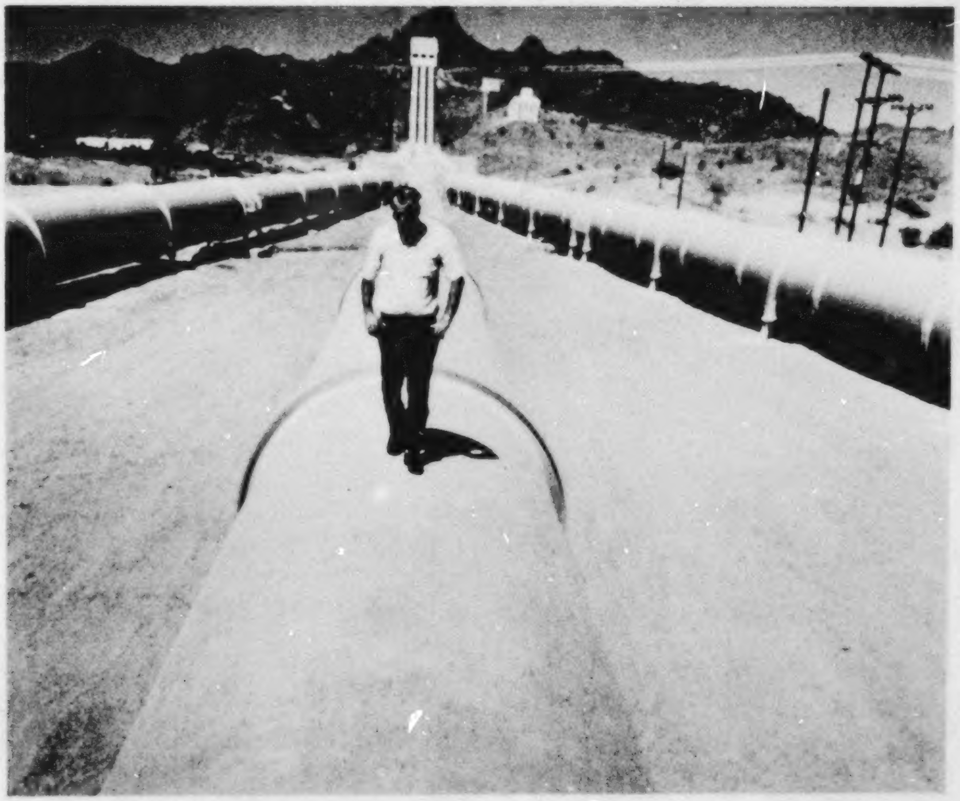
INTRODUCTION

This past century can be characterized as one of great and exciting leaps in science and technology. Our country, once a small agricultural nation, is now one of the industrial leaders of the world. We have sent men to the moon; with television the entire nation can see and hear the latest news event; our home appliances do the work of several people with just the flick of the switch; and we can travel from one end of the country to the other in a few short hours. The growth of our country and our life of many comforts and conveniences are products of advances in science and technology and our bountiful natural resources.

But our achievements have not been accomplished without damaging environmental consequences. Many of the effects are beginning to emerge and confront us on a daily basis. Just a glimpse of the news reveals questions of growing concern: Will we run out of fuel to heat our homes? Are we being poisoned by contaminants in the air? Is our water safe to drink? Have we stripped our lands so bare that they can no longer support any form of life? Have we eradicated so many plants and animals such that their descendents can be found only in zoos and museums? Perhaps, much truth is contained in Barry Commoner's fourth law of ecology, "There is no such thing as a free lunch." While we have grown and developed, we have placed many strains and stresses on our natural environmental systems, often excessively. Resources such as land, water, minerals, and animals have been used with abandon as if there could be no limits or adverse effects. Yet, as we encounter increasing examples of environmental distress, we are beginning to realize that we cannot continue along the course of unrestrained exploitation.

We are thus faced with the perplexing question, "How can we maintain a life-style to which we have grown accustomed and at the same time maintain a healthy environment that will support life now and in the future?" We want a "good" life and a "good" environment! However, needs and desires conflict. We need gasoline to run our cars. But oil spills occur when we drill for oil in the sea beds or transport oil across the oceans. Oil spills kill fish and birds and spoil beaches. How to choose and act wisely in these many situations requires skilled problem solvers and decision makers, roles which you will soon assume. Choices are often difficult because there is not necessarily a single right answer. Choices involve knowing the facts, deciding what values are more important and being able to predict some of the possible consequences. Oftentimes, a decision means trade-offs — what are we going to give up in order to achieve a particular goal?

In this module twelve current and emerging environmental issues are considered. The topics are introduced through a series of readings. Associated with each set of readings is a hypothetical dilemma suggested by an actual case history or a future possibility. The dilemmas have been designed to stimulate discussion between yourself and your classmates. It is hoped that the readings and discussions will challenge you to think about how our various activities affect the environment, and the need for wise and responsible environmental decision making. By thinking creatively and considering a range of alternatives, you will be developing your skills in choosing.



Whose Water?

Reading 1

Colorado River, Vital To Southwest, Travels Ever-Rockier Course

by William E. Blundell, Staff Reporter

Demands on It for Irrigation, Power, Drinking Water Develop Into Tug of War

Do Indians Hold Best Club?

More than a century ago a young Army officer named Joseph Christmas Ives sailed up the Colorado River to explore it. In the barren desolation of the lower basin, he was stopped near here by deep gorges and wild water. "Ours was the first and doubtless will be the last party of whites to visit this profitless locality," he reported.

Lt. Ives was a lousy forecaster. Today the river, rising high in the Colorado Rockies, is the aorta of the nation's fastest-growing region. It winds 1,400 miles through seven states with a total of 29 million people — most of them beneficiaries, in one way or another, of its waters. To accommodate them, the Colorado system has been so dammed, conduited and channelized that in some reaches it more resembles a plumbing works than a natural feature.

The Colorado originates in Rocky Mountain National Park at an elevation of 14,000 feet. Driven under the Rockies in tunnels and across the deserts in aqueducts, it helps slake the thirst of 11 million people from Denver to San Diego. Diverted into canals and ditches, it waters 3.4 million acres producing crops worth well over $1 billion yearly. Forced through turbines, it sends electricity leaping out of canyon power plants to more than 200 utilities, rural electric co-ops and others. The only substantial source of surface water in the Southwest, it is relied upon as few rivers are anywhere.

Troubled Waters

But the Colorado is an increasingly weary, troubled stream. Its water quality is deteriorating, and unre-

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solved legal questions over use of its flow may touch off litigation that could take many years to settle. Above all, there simply isn't enough water in it to meet all projected needs. "We're coming to a crunch on the Colorado, and it may be felt nationally," says Prof. Albert Utton, a resources law expert at the University of New Mexico Law School and editor of Natural Resources Journal.

Depending on varying assumptions about the river's average future flow and the pace of development in its basin, the Colorado could come up short in the early 1990s, or it could last well into the 21st Century. As the demands on the Colorado increase, decisions on who gets the water could have an important bearing on national energy development.

New Mexico, Colorado, Arizona and Utah have at least 23.5 billion tons of recoverable coal that utilities could use for huge water-cooled power plants near mine sites. Almost all of the nation's oil shale lies under Colorado, Wyoming and Utah; this too would take a lot of water to extract.

A 1974 Interior Department study estimated that by the year 2000 the amount of water that might be needed for energy alone in the upper-river basin, where the resources are concentrated, could be as much as 25% of the total amount now used there for all purposes. (Wyoming, Utah, New Mexico and Colorado are the upper-basin states. The lower-basin states are California, Nevada and Arizona.)

Determining Priorities

If energy gets priority for the river's water, irrigated agriculture may have to be curtailed. This would depress the big farm-based economy of the so-called Desert Empire and might also be felt by housewives from Hackensack to Seattle. The region's irrigated farms, with a year-round growing season permitting double and even triple cropping, produce an outsized share of the nation's fruits and fresh vegetables, particularly in winter.

The prospect of painful tradeoffs grows closer with every new water project, but the development juggernaut rolls on; every state the river serves wants to be sure it gets to use all the water it is entitled to — whether the water is really there or not.

More irrigation projects are being built or planned for Colorado and New Mexico. The million-dollar, multipurpose Central Utah Project continues. Nevada will soon take more water to satisfy booming Clark County. And construction has begun on the Central Arizona Project aqueduct, an enormous drinking straw that will begin sending large amounts of water to Phoenix and Tucson by 1985.

Use of the river's water was first spelled out in the 1922 Colorado River compact, an agreement among the basin states. Moses-like, the bureaucrats parted the waters at the Arizona River crossing of Lee Ferry, decreeing that states served by the drainage above that point get 7.5 million acre feet of river water yearly and states below it the same. The upper basin, which has almost all the tributaries, became guarantor of the lower basin's share. In 1944 Mexico, by treaty with the U.S., got a share of its own, bringing total river entitlements to 16.5 million acre feet a year. (An acre foot is an acre of water one-foot deep.)

But this doling out of the Colorado was based on a brief history of river flow in a freakish wet period; the river has refused to follow orders since.

The U.S. Bureau of Reclamation, which operates the river's major projects, now uses a 67-year average-flow figure (including the wet period) of just under 15 million acre feet a year in helping to justify new water developments. Using this estimate, and assuming the U.S. decides it likes foreign oil well enough to undertake only modest development of the river's energy resources, there would be enough water to last far into the next century.

But other studies indicate that the average flow of the Colorado over a 400-year span has been about 10% less than the 67-year-average, and over the past half-century it has been about 13% less. With these lesser flows and all-out energy development, allotted river shares would be exhausted by the early 1990s.

Until recently the river's deficiency, whatever it may be, wasn't important. The basin states weren't using nearly all the water anyway, and they stored surplus in reservoirs. The new projects, and the potential for energy use, are changing that.

After 1985, when the Arizona and Nevada water projects are to be operating, the tri-state lower basin will be using its full allotment, river-related development will halt, and a lot of Southern Californians may get thirsty. The Metropolitan Water District, biggest supplier in the area, has been pumping up to double its entitlement into Southern California because Arizona wasn't using all of its share. But the Central Arizona Project will devour the surplus, and the Metropolitan Water District will be cut back.

Southern California had been counting on filling the gap with expansion of the California Water Project, which brings water from northern areas of the state, but that expansion has been delayed, and no one can tell when, or even if it will be finished. "If they started tomorrow, it would still take 10 years to get anything more down here," a Metropolitan Water District spokesman says.

A Ghost River

In the upper basin of the Colorado, pressure for legal conflict with the lower basin is likely to grow. The upper states are penalized by the Colorado's anemia; after metering their lower-basin and Mexican deliveries through Glen Canyon Dam to Lee Ferry, they don't have close to their legal allotment left for themselves. This, they contend, is a violation of the intent of the 1922 compact, and they are thirstily eyeing the Gila River system, which traverses Arizona and joins the Colorado deep in the lower basin.

The Gila is a ghost river, carrying water (along with uprooted trees, boulders and an occasional auto) only during rare flash floods. Its headwaters and principal tributaries are dammed and entirely consumed in central Arizona; without them Phoenix would be coyotes and cactus.

The upper basin says the Gila's virgin flow — what it would give the Colorado if it were allowed to — should be counted as part of the total available river supply. If this were done, the upper states would get credit for half of it and wouldn't have to send an extra supply for Mexico down the river, as they do now.

The thought horrifies lower-basin authorities, and the Gila issue is a lawsuit waiting to happen. "There is almost certain to be litigation over this," predicts Ival Goslin, executive director of the Upper Colorado River Commission.

Far northeast of the Gila's mouth, in the red rock country and the arid plateau lands of the Navajo reservation, another time bomb is ticking. Both the states and the federal government ignored Indian water rights in parceling out the river. But the tribes, newly militant, conceivably could win an enormous share — particularly the Navajos, whose 24,000-square-mile enclave spreads into four states.

Guarantees to Indians

Two Supreme Court decisions guarantee water supplies to federal reservations and indicate that the amount of entitlement could be enough to water all the "practicably irrigable" acreage on them. The Navajos haven't yet pressed a lawsuit, but they have had a survey of irrigable land. Tribal counsel George Vlassis won't say how much there is but adds, "It's enough to eat up about all the water in the Colorado."

That kind of talk scares the daylights out of non-Indian water users who have billions invested along the river, and well it might. "If a major Navajo claim is upheld, it could have tremendous impact," says Manuel Lopez Jr., the U.S. Bureau of Reclamation's director for the lower Colorado region. "The 1922 compact might have to be changed. It would be the longest drawn-out proceeding you could imagine, and it would probably freeze all development, Indian and non-Indian, until is was settled."

Mr. Lopez and others, however, have a more immediate problem: arresting the decline in river quality. Nature's price for conversion of the Colorado into a spring of sapphire lakes is that a huge amount of water evaporates uselessly into the air. This concentrates salinity in the water left behind, and agricultural runoff adds much more salt. The result: About half the 11 million tons of dissolved salts carried through the river yearly is man's work.

A Kind of Salt Agreement

Salinity grows with the southward flow. Farmers near Yuma, Ariz., and across the border in California, where a cluster of irrigation districts take a last mighty gulp through the All-American and Gila Canals before passing the remnant trickle to Mexico, have a rule of thumb: Put a foot of water on an acre of land and you apply a ton of salt along with it.

Farmers in the Mexicali Valley south of the border have been even more affected, and relations with Mexico became so strained that the U.S. agreed in 1973 to reduce the salt. This has prompted a costly program — $350 million and climbing — involving retirement of some farmland, lining of canals and construction of a $220 million desalting plant near Yuma. (None of this benefits U.S. users; more salt-control projects are underway for them upstream.)

One curious feature: The so-called Regulatory and Protective Pumping Unit, a battery of groundwater pumps being installed near Yuma. They will confront a similar array on the Mexican side currently taking groundwater from a deposit straddling the border. The U.S., fearing the groundwater will drain over to Mexico, couldn't get that nation to stop. Finally, both sides agreed to pump equal amounts; the U.S. will pipe its share into the Colorado to dilute salts and help meet the Mexican water share from the river.

"It's a pumping war," says an irrigation district chief. And it's a strange war, in which the generals have agreed to inflict precisely the same casualties on each other. The cost of the pumping program to the U.S. taxpayer: $42 million. "Frankly, we're embarrassed about the price tag on some of these things," one reclamation bureau official says.

There may be a far cheaper way of boosting the weary Colorado's flow by much larger amounts: making it snow a lot more.

Cloud-Seeding Test

From 1971 through 1975, the reclamation bureau conducted a cloud-seeding test over Colorado's San Juan mountains. The test was too limited to be scientifically conclusive, but results were promising enough to convince bureau scientists that a full-scale seeding program could boost river flow by as much as 8% to 9%.

If so, the bleak future sketched for the Colorado suddenly brightens. The extra water from melted snow would add a sizable cushion to river supplies and help ease the salinity problem as well. But what if there are few clouds to seed?

More than 700 years ago, the classic pueblo civilization of the Southwest reached its apex. Nourished by streams and rivers flowing from the mountains, the Indians irrigated land, built cities and developed a culture. In 1276 a great drought gripped the region, and this civilization apparently withered, leaving behind only the empty, eerily silent pueblo cities nestled under cliffs.

That drought lasted about 25 years. Today's desert civilization relies on the Colorado's two main reservoirs, Lakes Powell and Mead, to tide it over during drought. They hold a four-year reserve.

Reading 2

Warning: Water Shortages Ahead

Water, water, everywhere,
Nor any drop to drink.

These words of Coleridge's Ancient Mariner could well have summarized the gloomy outlook of scientists and Government officials last week at the United Nations conference on water at Mar del Plata, Argentina. While the assembled experts agreed that the global supply of usable water is as great as ever, they warned that it may soon be inadequate to slake the world's growing thirst. The day is not distant, warned Syrian Delegate Saub Kaule, when "a drop of water will cost more than a drop of oil."

Ominous Increase.

As spacecraft pictures of the blue-green earth so dramatically show, the planet has an abundance of water. The problem is that very little of it is directly usable by man. Fully 97.3% of the world's 1.4 billion cubic kilometers (8.7 million cubic miles) of water is ocean and thus unfit for drinking or agriculture. Of the 2.7% of the water that is fresh, more than three-quarters is locked either in glaciers or polar ice. Another large portion of the remainder is trapped as so-called fossil water in underground aquifers, some of them thousands of meters below the earth's surface. Indeed, of all the world's fresh water, only .36% in rivers, lakes and swamps, is easily accessible and available for human use. Says Gilbert F. White of the University of Colorado: "The form and localization of this usable water can be altered by human activity, and its quality can be improved for better human use. But the total always remains the same."

The demand on this limited supply has been increasing at an ominous rate as more and more people use

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[1] Reprinted by permission from TIME, The Weekly Newsmagazine; April 4, 1977, Copyright Time Inc. 1977.

water not only for drinking and cooking but to bathe, flush toilets, wash cars and water lawns. While a human in the semiarid lands of Africa may use no more than three liters (.8 gal.) of water a day, those in the developed countries are more profligate. According to a report presented at the U.N. conference, London uses 263 liters (68 gal.) a day per capita, Paris 500 liters (130 gal.), Moscow 600 liters (160 gal.) and New York City 1,045 liters (270 gal.). Even if individual consumption is reduced, total demand is likely to continue rising; the world's population, now more than 4 billion, is expected to increase to as much as 7 billion by the year 2000.

Still, the amount of water used directly for human consumption does not compare with the quantity required for agriculture, which accounts for at least 80% of all the water used by mankind. Between 30% and 40% of the world's food production is now dependent on irrigation. As population grows and the demand for food increases, additional irrigation will be needed to cultivate marginal farm land for necessary crops. Industry is also using ever increasing amounts of water — to generate electricity, to cool nuclear reactors and manufacture chemicals and metals. As a result, many lakes and streams have been so badly polluted by agriculture and industry — as well as by the wastes from increasing numbers of humans — that they have become unusable without expensive treatment. Despite purification measures, the need to take drinking water from contaminated sources has caused widespread disease. The World Health Organization estimates that as much as 80% of the world's cases of disease are traceable to unclean water.

Dry Wells.

Recent dry spells have made the world even more conscious of just how limited global water supplies really are. In many areas of the U.S. West, for example, the current drought *(TIME, March 7)* has accelerated the depletion of underground aquifers already strained by the rapid growth in population and agriculture. Many wells have already run dry, forcing farmers to dig deeper and more expensive ones in an effort to reach the declining water levels. Some farmers in the Texas Panhandle, who have been drawing their water from the deep and bounteous Ogallala aquifer, calculate that their wells will run dry — drought or no drought — soon after the year 2000.

In other areas, though, there are ample reserves — including an aquifer recently discovered under northeastern Wyoming that experts believe might yield as much as 6,000 liters (1,600 gal.) a minute for decades to come. "There is plenty of water in the U.S.," says Donovan Kelly of the Department of Interior's Geological Survey. "It's simply not where you need it."

Some countries are trying novel approaches to meet their water needs. Saudi Arabia has contracted with a French firm to study the feasibility of towing an iceberg from Antarctica to a Red Sea port, where it could be melted for its fresh water. Elsewhere, more conventional methods are being used to increase the supply of usable water. Among them:

Desalination.

Though Israel — which gets little or no rain for up to eight months of the year — draws much of its water from the Jordan River, it also gets part of its supply from the sea. Israeli desalination plants now desalt 3 million cubic meters (7.8 billion gal.) of sea water every year. The cost is high ($1 per cubic meter), but the Israelis have little choice. In Saudi Arabia, where cost is no object, the government has embarked on a $12 billion program that will enable it to desalt 2.3 billion liters (600 million gal.) a day by 1980. Oilrich Kuwait already gets almost all of its water by desalination.

Deep Wells.

By sinking wells, Egyptian geologists are attempting to tap the vast underground reservoirs that are believed to lie beneath the Western Desert, some of them as much as 1,200 meters (4,000 ft.) below the sand. "Getting at this water," says Egyptian Geologist Rushdi Said, "will make it possible for man to again live in the desert." But only for a while. Filled at the rate of only millimeters a year, these reservoirs of fossil waters are replenished so slowly that for all practical purposes their contents are finite. Though they may yield water for centuries, all will eventually run dry.

Recycling.

Some countries are stretching their water supplies by reusing water. The Japanese are testing a system under which water is first used for human consumption, then for industrial purposes. Finland's pulp and paper industry is trying a system under which it recovers its waste and reuses its water rather than drawing heavily on fresh supplies. Other countries require manufacturers and power companies to install closed-circuit cooling systems instead of allowing them to continually withdraw water from rivers or lakes.

River Diversions.

The Australians are diverting much of a river for irrigation; water from the Snowy River, which empties into the Tasman Sea, is being rerouted to flow through the Snowy Mountains into farm-land watering systems. The Soviets are working on a similar project involving the Ob and the Yenisei, which flow north out of Siberia to the Kara Sea. By diverting part of these waters southward, the Soviets will feed them into an irrigation system that could keep marginal wheatlands productive.

All these approaches will help ease but cannot meet the world's growing need for water. No matter what is done to stretch water supplies, they will become inadequate if man continues to waste and contaminate them — and to reproduce in numbers that strain all natural resources. The world is getting thirstier by the day, and unless it starts saving water now, it may find the well dry tomorrow.

Reading 3

Reclaiming Los Angeles[1]

Reading 3

RECLAIMING LOS ANGELES[1]

Do you know that the Los Angeles area also was once practically all desert? It still would be, if new supplies of water had not been brought to it at great expense and after battles with other communities over water rights.

A visit to the city is deceiving. On all sides are gardens of flowers, lush lawns, and rows of stately palms. Just outside the city are mile after mile of orange, lemon, and walnut trees.

Yet since its beginning almost two hundred years ago the city has been plagued by water problems and fears. Droughts in some years so dry up the brush and timber in the Hollywood Hills that they burst into spontaneous fire. By doing so they destroy the very vegetation that could delay the runoff of water at other times. On other occasions Los Angeles is visited by deluges of rain that cover the streets with 12 to 24 inches of water.

At the turn of the century Los Angeles and the several small communities surrounding it received all their water from a strange looking bed of sand known as the Los Angeles River. There was nothing about the dusty wide channel that suggested a source of water. Under the dry surface, however, were ample streams of ground water, which could be cheaply pumped to the surface and distributed by a system of ditches and pipes.

Then, more people began moving into the Los Angeles area. Only 5,728 people lived in the city in 1880. Ten years later, the population had jumped to 50,000 and by 1900 it was over 100,000.

A series of extremely dry years in the 1890s made the water problem urgent at that time. Civic leaders began desperately looking for other sources of supply.

Among these men was Bill Mulholland, a tall, broad-shouldered man of both great physical energy and vision. Bill had come to California from Ireland as a young man in 1877, and gone to work as a caretaker of the ditches that then supplied Los Angeles with its water. He studied geometry and engineering at night, was promoted to foreman, and later became superintendent of the water system. He became convinced that his adopted city would attract countless people if it had adequate water supply.

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[1] This selection is excerpted from *This Thirsty World: Water Supply and Problems Ahead*, by Alfred Lewis, McGraw Hill, New York, 1964, pp. 28-34. Used by permission.

In their search for new water, Mulholland and his associates first thought of the Colorado some three hundred miles to the east — a source that the city now shares with others — but the plan did not seem practical at the time. They turned their attention in a different direction.

The engineers went by horseback and by foot far north to the eastern slopes of the Sierra Nevada, just across the mountain from where San Francisco and the San Joaquin Valley receive parts of their supply. They found a plentiful supply of water here, creeks and streams emptying into a dead-end salty basin known as Owens Lake.

The only trouble was that a small but thriving group of farmers already were using part of the water. They had no desire to surrender their rights to Los Angeles.

The courts and federal government, however, ruled that Los Angeles had the greater need for the water. So in the next five years, from 1908 to 1913, Mulholland and his assistants built one of the most amazing aqueducts ever built to that day, a system of ditches, giant pipes and tunnels that stretched 250 miles from Owens Valley to the outskirts of Los Angeles.

A War over Water

Local residents did not give up, however. For the next dozen years a "civil war" raged in California, as Owens Valley farmers fought to stop water from flowing down to Los Angeles. Both farmers and aqueduct guards went around the valley armed with rifles and shotguns.

"Shooting the duck" became the favorite sport of Owens Valley farmers. This consisted of blowing up sections of the aqueduct with dynamite. They did this over and over again. A group of armed farmers on one occasion even captured the main gates at the beginning of the aqueduct, and for several days allowed the entire flow to spill out into the desert.

The struggle eventually ended in the 1920s with a truce and a compromise. The city of Los Angeles won a guaranteed supply of water — a supply that was to prove inadequate in a very few years — but it was forced to spend millions of dollars to buy up all the land in the Owens Valley.

Though California's water "civil war" was regrettable, the engineering that went into building the aqueduct more than fifty years ago was monumental. To build his 250-mile water line, Mulholland first had to lay out a new railroad, set up a huge cement plant, construct 500 miles of roads. The aqueduct runs along the foothills forming the western border of the Mojave Desert. In this area, Mulholland had to tunnel through a series of mountain slopes, run 10-foot steel pipe up and down canyon walls, and build a number of dams, reservoirs, and power plants.

Mulholland's fine achievement was marred by tragedy almost before peace had been restored in Owens Valley. Some years after the aqueduct had been completed Mulholland decided his system needed another dam to collect water from the two power plants some fifty miles above the end of the aqueduct. St. Francis Dam was completed in 1926.

It was built on faulty ground, however, and on March 12, 1928, before the dam was two years old, it gave way. Wings of the dam crumbled, and a hundred-foot wall of water rushed down San Francisquito Canyon carrying with it huge blocks of concrete, houses, trees, automobiles, and telephone poles. Four hundred and fifty people were killed, and hundreds lost their homes.

Bill Mulholland accepted personal responsibility for the tragedy, and never got over it. He retired later that year, a broken-hearted man of seventy-three, and spent the remaining few years of his life in lonely visits to the water system he had built.

California Looks Ahead

Others have carried on where Mulholland left off. Almost before the Owens River aqueduct was in full operation, Los Angeles officials decided that its supply would not be enough for the city's future needs. By the 1930s they were building extensions of the aqueduct to tap more northern creeks of the Sierra Nevada, and they were making arrangements to corner some of the water of the Colorado River. Both systems now are in operation.

Despite this added supply, Los Angeles and the rest of California are still building water systems for the future. The multibillion dollar system now being engineered, known as the Feather River Project, will tie substantially the entire state into a single water system with more than 650 miles of ditches, pipes, dams, and pumping stations. Much of the water will come from a plentiful supply in the headwaters of the Sacramento and its tributary, the Feather River. Greater storage is being assured by damming up the Feather River with the 735-foot Oroville Dam, a concrete structure as high as a 75-story building.

The system will eventually serve San Francisco, Oakland, the Central Valley, and then go on to Los Angeles and San Diego. It will consist of several aqueducts, a number of large reservoirs, and will have connecting links with most existing rivers, canals, and aqueducts.

Dilemma 1 — WHOSE WATER?

Following a long drought 50 years ago, the city of Los Amos recognized that further growth would be greatly limited because it lacked an adequate supply of fresh water. To help plan for its future, the city officials at the time entered into a series of 150-year contracts with water supply agencies in several areas. One contract was made with the Basin County Water Company, a privately owned corporation in northwestern Idaho, several hundred miles away.

When the contract between Los Amos and the Basin County Water Company was made, Basin County was a small mining community with an abundance of fresh water. Since then, the mines have "played out" and the people have turned to farming. During the last two year, however, a severe drought created a tremendous water shortage in the area.

Several months ago the residents were ordered to reduce their use of water by 20 percent, and this week they were required to cut back another 10 percent. This angered the people of Basin County. They felt that they should not have to make sacrifices just so that the people in Los Amos could have all the water they wanted. They demanded that the Basin County Water Company stop taking their water away and selling it to others. Their crops were wilting from lack of sufficient water.

The Basin County Water Company refused to break the contract. The company felt that it had a right to sell water to whomever it wanted. A group of citizens of Basin County became so enraged that they planned to takeover the water supply stations and stop the water from going to St. Amos.

Should the citizens take this action? Why or why not?

SAMPLE OPINIONS

Mary "Yes. This is the only reasonable thing for them to do. The Water Company is taking their water; they need that water for their own use. Besides, it's from their own land. It's not fair to ask them to sacrifice and suffer when the people of Los Amos do not have to ration water.

This is an emergency situation, and Basin County people have the greater need for the water. The people of Los Amos should recognize their problem and be willing to give up some of their own comforts.

Anyway, the Water Company was being totally unfair when it imposed those reduction quotas on the community. Really, the Water Company is forcing the citizens to shut the pipelines."

Paul "No. The citizens of Basin County have no right to force the Water Company to break its contract. Contracts are made on good faith on the part of the parties involved. If contracts were broken at the whim of any party, our whole legal system would fall into a state of confusion. The company has the legal obligation to uphold its part of the contract.

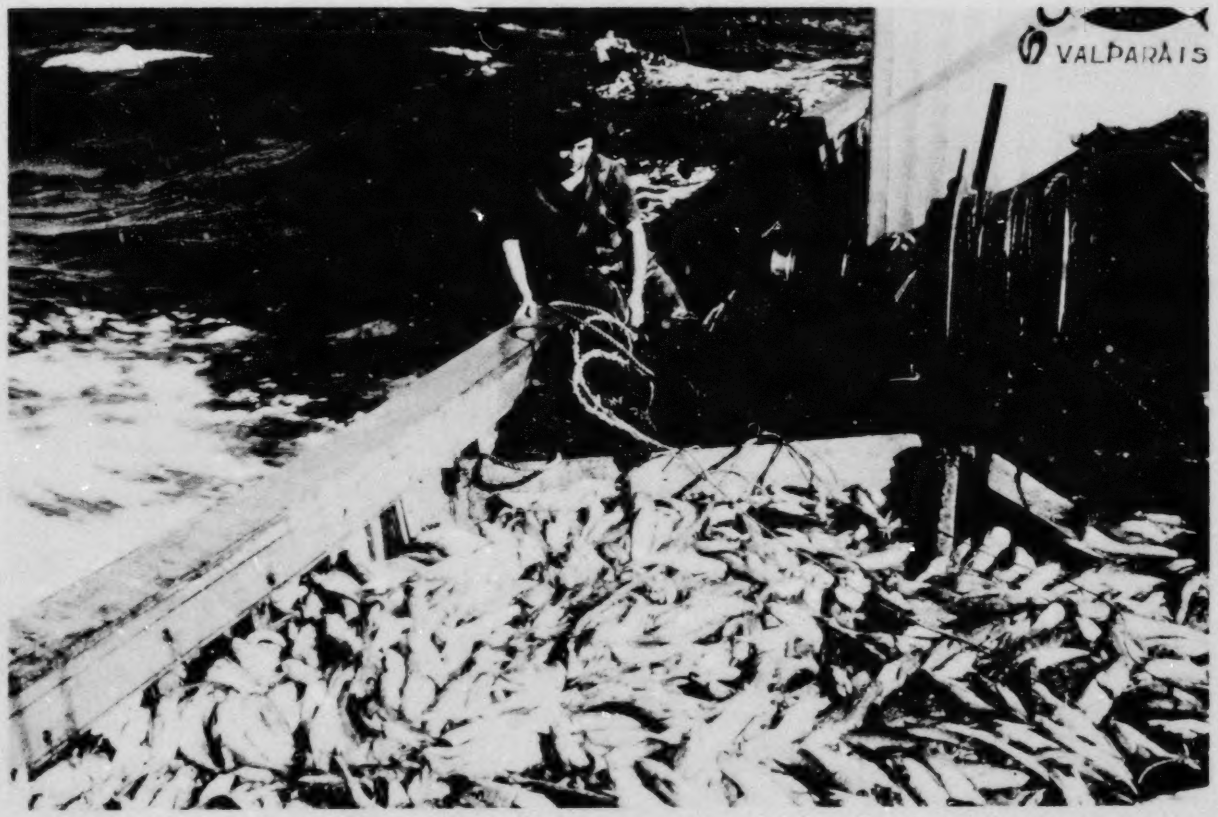
Before they started farming Basin County, residents were aware that the water rights were owned by the Water Company. They should now have to live with what water they had originally bargained for. They were allowed their share. Now, because farming has created new demands for water, they have exceeded what was originally allotted. Why should they be given a larger share because their needs changed?"

June "Yes. The citizens have a right to challenge a contract which does not protect their basic and inherent rights. In this case it is the right to a livelihood and a decent life. Their very survival is at stake, and a contract that violates this is an unfair contract.

Contracts must be fair to everyone. Moreover, contracts must make allowances for unpredictable natural disasters. I believe civil disobedience is justified when a contract or rule makes unfair demands of people."

DISCUSSION QUESTIONS

- Should the concept of "first come, first served" be followed in this case? Why or why not?
- How might society be affected if contracts are made and broken at whim?
- If you were a judge hearing the case against the Basin County citizens who took over the pumping stations, (a) would you find them guilty of committing a crime? If so, what crime? Why? (b) Should they be punished for that action? Why or why not?
- In a situation where the welfare of the community is at stake, do the people have a right to take the law into their own hands? Why or why not?
- The Basin County Water Company felt that it had to abide by the contract — a lawfully developed document. (a) Was its action in doing so appropriate? (b) Should it have acted otherwise? Why or why not?
- Should the Basin County Water Company be accused of stealing in any sense of the word? If so, from whom did it steal?
- To whom does the Basin County Water Company have a greater obligation — to the Basin County residents or those of Los Amos?
- Should the people of Basin County have gone into farming which required large amounts of water when they knew that much of the water was contracted for by another area? Why or why not?



Who Shall Eat?

Reading 1

The Harvest Of The Seas: How Fruitful And For Whom?[1]

One phase of the world food issue is increasingly becoming the focus of attention. This is the role of the ocean, and it, more than any other area, is subject to a great deal of misinterpretation.

As a preface, take note of the overall situation today. We are faced with a backlog of no fewer than 2.5 billion people in the world who are short of almost everything, particularly food and water. In terms of food, the protein shortage is most evident. We are in an unprecedented population explosion, adding a number of people each year which is equivalent to the population of three Canadas or, if you prefer, a new United States each third year. This means that in terms of the next ten years we have to find food for no fewer than 1000 million more people. . . .

You have undoubtedly read about the oceans being an almost limitless source of protein, a reserve of food for almost any number of people. Look at what has happened on the marine scene. With a certain pride, the fisheries people have pointed to the fact that world fisheries — in contrast to world agriculture — have been able to match the growth of the human race with their increase in catches. There has hardly ever been a period in the history of mankind in which so much emphasis has been put on the development of world fisheries. Never in the history of world fisheries have such tremendous gains been made as in the postwar period. We have more than tripled the catches, and we have provided for large new modern fleets operating in almost all waters. Hardly any major fishing grounds remain that are not visited by fishing fleets. . . .

This is a period of revolutionary upheaval in world fisheries. First, the big new fleets are provided with super-modern electronic devices, with new gear, and with new materials superior to anything they ever had in the past. Second, to a much greater degree than ever before, the catching fleets are provided with processing facilities such as refrigerated holds, and freezing, salting, and drying facilities. . . .

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[1] This selection is excerpted from "The Harvest of the Seas: How Fruitful and for Whom?" by Georg Borgstrom, in Harold W. Helfrich (Editor), *The Environmental Crisis: Man's Struggle to Live With Himself*, Yale University Press, New Haven, Connecticut, 1970, pp. 65-84. Reprinted by permission.

A major oceanic event is the installation of large reduction plants for the production of oil and meal from fish. Such major bastions have been created on the Pacific coast of South America — Peru and Chile — as well as on the Atlantic coast of southwest Africa. The Pacific catching is in the Peruvian Current off the Peruvian-Chilean coast, and the factories are land based. Southwest Africa is partly using converted whale-factories as floating reduction plants.

Some statistical data will indicate the significance of the Peruvian-Chilean takes. More than 95 percent of the catch of Peru moves into the floating reduction plants, and this is in the form of a single species, the anchoveta (*Engraulis ringens L.*). The species is a herbivore and consequently close to the primary production. This catch reached 9 million metric tons in 1964 and 12 million metric tons in 1967. The corresponding 1967 African catch was 2.5 million metric tons, an annual increase of 225,000 metric tons in the same period from 1965.

In terms of fish quantity, this means that Peru is surpassing both Japan and the USSR in their worldwide operations. This says something about the fish abundance of these waters, but it also is a clear indication of what can be done with purposeful action. Most of these rich catches are, however, bypassing the adjacent protein-hungry continents. This applies to tropical Africa and the resources of the Benguela Current as well as to South America and the Peruvian (Humboldt) Current.

The oceans are mobilized in this tremendous way to feed the well fed; no less than 45 percent (1967) of the marine catches are channeled to fish meal; more than one third serves as food to the satisfied world; and only 17 percent reaches the hungry nations. In addition, as regards the Peruvian operation, we are committing once again the same tragic mistake: we pay no attention to biology. The biologists have made close studies of the productivity of the water that can be reached by the present catchers. It is important to realize the immensity of this operation, the great numbers of catchers that have been constructed, and the fact that this has been the chief source of local income and employment. The labor required in the plants themselves is smaller because they are highly automated. This big operation backfired in 1964, when the catches reached 9 million metric tons. The catches started to drop drastically for each individual ship and fishing effort. The take in the following year (1965) was reduced to 7 million metric tons. Biologists have been saying for at least 12 years that the maximum sustained stock did not allow more than 7 million metric tons.

The fact remains that there is considerable overfishing. But this is small compared to the "potential" overfishing. If you look at the investment that has been made in this industry and consider the number of its ships, and if you add up what catches they could take, the potential of the present investment exceeds a catching-vessel capacity of 20 million metric tons. This partly explains why there is such an economic crisis: fleet owners do not get the return that is required for invested capital. All the way through, this operation exemplifies an irrational, unplanned, and very shortsighted undertaking. It is, furthermore, narrow in scope in terms of the current situation in which a world short of protein exploits the oceans to feed the well fed but allegedly in the name of providing food for the hungry. The news media constantly reiterate that we are working the oceans with the aim of feeding the hungry. The truth of the matter is that the hungry of the world by and large are relegated to the sideline. Ever since World War II, the ocean catches have climbed unceasingly. This is due to the Japanese and Soviet expansion and, in addition, that of China. The major driving force has, however, been unbroken increase in the reduction plants' capacity to handle larger catches of fish.

A persistently higher percentage of the world's ocean catches has been channeled into the feeding troughs of the rich Western world for the raising of broilers, egg layers, hogs etc. The essential fact is this: only about 8 million metric tons (720,000 ton protein) of the total yearly catch from the oceans go to feed hungry people.

We are rapidly approaching the point where almost half of the ocean outtake is moving into reduction plants. More than half of the herring catches of Norway and Iceland is flowing into this very channel. This is ominous because it means that the oceans have become the reserve of the well fed. Fish oil has moved the same way; that is, to feed the satisfied world. These oils are part of the raw material used by the margarine manufacturers of western Europe. The U.S. menhaden catches follow the same pattern. We use the meal ourselves chiefly for broilers, but the oil is "sold" to the Netherlands, West Germany, and other countries.

When I read the catch phrase "Freedom from Hunger," I have always asked myself, "Freedom from Hunger — for whom?" It is obviously not for the hungry. Today they get only a pittance of the world's ocean catches. They show some gain, however, in that they are major beneficiaries of fresh-water fish. Subsistency fishing has been developed and expanded in some areas where they also are the main recipients. Otherwise, on the marine scene this high-rate protein is moving away from the needy.

How big is this outflow or net loss to the hungry world? If you take the South American delivery to the world market, a little less than one third goes to the United States and two thirds to western Europe. In terms of total amount of protein, this exceeds by 50 percent (1965 to 1967) the total meat protein production of the South American continent. It is, furthermore, twice the milk production of South America.

We could put the situation into a historical perspective and describe it this way: in the last 300 years, the white man has mobilized the grasslands of the world to his benefit. He has gone all over and taken the prairies and the pampas, the grasslands of Australia, many of the grazing grounds of Africa, including the South African veld — all this chiefly for his own benefit. He has very little account of the people who were there originally; he has killed them off, chased them away, or provided them with calories devoid of adequate amounts of protein.

Seen in this perspective, the present large-scale exploitation of the oceans might be called our latest big swindle. As Western white men, this time we are going out to the "grasslands" of the oceans: the plankton pastures. We are mobilizing them, not to feed the hungry, not to feed the continents closest to these lush pastures, but to feed ourselves. . . .

Note a few other things that have happened. One is the expanding use of freezing. This process has made the fish still more attractive to a demanding market. Freezing is also a first-rate method for preserving fish. But did you ever think about the fact that salted and dried fish have dominated world trade in fish for centuries? As early as the Middle Ages, Europe was depending on salted herring and salted cod. It seems evident that the Portuguese were in the Newfoundland Grand Bands prior to Columbus' discovery of America. The Caribbean area was dependent on salted or dried cod from the New England states — actually the main income of Massachusetts for quite a number of decades. . . .

Through freezing we are doing something similar today. The white-fleshed fish — chiefly cod and related species — are channeled primarily into the cutting of fillets. The amount available for traditional drying and salting is correspondingly reduced. Processors look upon salting and drying as operations that belong to bygone days, yet these markets are big and unfilled. The switch from salting and drying of fish is readily explained by the greater profit available from the sale of raw fillets. This trend is most evident in Norway, but also in West Germany, even to the point where European markets seem to have difficulty competing with the U.S. prices offered. This aspect need not occasion too much worry. Far more crucial is the fact that for many centuries the needy world has been the chief buyer of such white-fleshed fish! The United States also is the purchaser of a large part of the Canadian catch and production. The needy world, in a population explosion and with tremendous protein needs, thus is deprived of one of the main sources of first-rate, cheap animal protein, a source on which it has long been dependent. This is reason for more serious concern. People do not realize the fact that dried cod is the most perfect fish protein concentrate the world has ever had and probably ever will have.

We talk about all these fish used in the manufacture of meal as if they were "trash" fish — a common U.S. designation. Sometimes these varieties are ambiguously called "industrial" fish. It is further maintained that these fish are really not acceptable as human food — or that most people would not eat them.

Anyone knows this is not true of herring, a first-rate food fish; still it is the main ingredient of the fish-meal production in Iceland and in Norway. The Danes have based their meal manufacturing on sand launce, which in Japan is a highly cherished food fish. Menhaden was well liked in pioneer days and was food for coastal Indians of pre-Columbian America. Anchoveta in its dried form was a staple food of the Incas, yet a U.S. expert at a scientific meeting responded to my inquiry with the assertion: "The Latin Americans will not eat fish, so we cannot do anything about that." My answer was: "It seems strange that with all the modern technology at our disposal we should be so much amiss compared to the experts of the old-time Inca empire." The conquistadors described their big granaries filled with corn, beans, dried potato (*chuño*), and dried anchoveta. The Peruvian coast, only rarely harassed by rains, is ideal for the deployment of air drying and dry storage. The Incas also developed a distribution system for their entire Andean empire. Furthermore, I have been through the Andean villages, and I have seen women actually tear each other's hair in a fight over the last fish stick (dried, from adjacent lakes or rivers) left in the local village market. The merchant broke the fish in two; he gave one woman the tail and the other the head. They certainly know the value of fish. They also know exactly how to use it. We have not addressed ourselves to this very important issue. . .

Ocean fishing, in other words, cannot continue to be the privilege of the rich. High-sea fishing, as it has become developed in the way I have described, is almost as demanding of capital as modern agriculture; thus, it is beyond the reach of the poor world, the two thirds of the globe which has an annual income of less than $200 per person. Yet western and eastern Europe, as well as the USSR and Japan, are forcefully pushing ahead in the construction of hundreds of additional fishing units of all types.

Overfishing, therefore, looms on the horizon, and has already become a serious threat to many species. The only remaining fishing ground of any significance is the Falkland Shelf which, as already mentioned, is rapidly being invaded after a temporary (1968) halt by heavy Argentine fishing fees based on territorial claims extended to 200 miles. Assuredly, the fleets now existing on earth are quite adequate to double the world's catches. It is something to think about. This is the degree to which we are lacking in international planning, as well as in economic consideration, for what we are doing. . .

Reading 2

Survival 2000: A Grim View

by George E. Brown, Jr.

Mass starvation is almost inevitable by the beginning of the next century, warns a U.S. Congressman. Western obsession with economic growth cannot continue much longer in the face of the world's limited resources, he says. Standards of living much higher than necessary for health and well-being are extravagances that may force millions of less fortunate people beyond the brink of starvation.

I take an extremely pessimistic view, probably worse than Malthus, of mankind's ability to avert mass starvation in the not-too-distant future. There is a possibility that we could solve the food problems of the world today if conditions were static, but unfortunately that is not the case. We have 4 billion people on the earth today and will have about 8 billion by the year 2000. I expect to be here to see the new century open, and then I hope to pass away before I am violently disposed of.

Even if we do solve the food problems of today, I doubt that we can muster the resources necessary to feed twice that many people 25 years hence. And what will we do about the 16 billion people who will be here by the year 2030? My answer is that we don't have a solution, and that there is no solution within our great western scientific-industrial tradition. There is, in my opinion, not the slightest possibility that the "green revolution" or any modification of it will come close to solving the world food problem. The new agricultural technology requires an industrial base which the underdeveloped nations now lack, and which requires tremendous quantities of hydrocarbon-based fertilizers, insecticides, fungicides, and fuels to power the equipment. This petroleum base will be exhausted, for all practical purposes, by the year 2000 or shortly thereafter. As if we didn't already have enough prob-

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lems, we seem to be on the verge of possible climatic changes which could drastically reduce the world's agricultural output. There is some evidence that we have enjoyed a period of unusually favorable climate for a number of years, but the earth has now entered a cooling trend which may have a massive effect on the great wheat-growing areas that supply most of the surplus food available to starving populations.

Man-Made Changes in Climate Foreseen

I am on the Science and Technology Committee of the House of Representatives, and we have recently had several days of testimony on the inadvertent modification of the upper atmosphere, popularly known as the "ozone problem" or the "freon problem." It seems that we have already, in all likelihood, released enough freon to reduce the ozone layer by a measurable amount over the next generation. If so, this will allow more ultraviolet radiation to reach the earth, and may cause a considerable increase in skin cancer. The increased radiation could have marked effects on almost all living things, from ocean plankton to Iowa corn, and could cause great changes in ecology and food production. Conceivably, a considerable portion of the biosphere could be destroyed. I wonder if using freon to propel underarm deodorants is sufficiently high on our scale of values to warrant the destruction of the ozone layer, inviting ecological disaster.

I see no way for modern technology to meet the need for a doubling or quadrupling of the food supply of the earth over the next 50 years. That is indeed a bleak picture. I think there are steps that can be taken which might help, and I will outline two or three so that you can see the magnitude of the problem as I see it and understand why I feel so pessimistic about our ability to solve it.

Unlimited Growth Is Suicidal

I do not think it is possible to solve the food problems of the world as long as we have the present disparity in wealth between the rich nations and the poor nations. We could meet the food problem today by the simple expedient of reducing our consumption of meat, which we fatten on scarce grains, thus releasing that grain for feeding hungry people. But we are not likely to do this as long as we live by the philosophy that our "just reward" for being good citizens and working hard, the reward which "the Lord has conveyed upon us," is to be 10 or 20 or 50 times as wealthy as the people in some of the poorer nations of the world. For us to conceive of anything other than that we "deserve" this great wealth, that is our "entitlement," that it is "the natural order of things," would be some form of heresy. This attitude, which maintains the present disparities of income throughout the world, is a part of the problem. If we are willing to accept a level of consumption that is only two or three times what is necessary for health and well-being, we can make giant steps toward solving the problem of hunger around the world. However, I do not see the slightest chance that we will accept the kind of philosophy, which runs counter to our whole system of values, our religion, and our lifestyle. Therefore, I have no hope that we will reduce the disparity of income.

A central aspect of the problem is our obsession with growth. We feel that we must continue to produce more and consume more. But the earth, with its limited resources, can no longer support the continuation of such a policy. I find the arguments for limits to material growth very strong, especially in regard to capital. To meet the energy needs of the world during the next 30 years will require a doubling or tripling of the capital investment in energy production. Substantial increases in capital input will also be needed if we are to continue at the present level of agricultural production in the U.S., and if we try to do around the world what we have done in this country in agriculture, the demands for capital will become almost overwhelming.

I see no tendency on the part of the political leadership or the people of the U.S. to accept the reality of limits, and my pessimism is increased by a very urgent, critical, immediate political problem. With the "business-as-usual" attitude that I must fight every time an election comes up, I may lose my seat in Congress if I am not careful. It is a very tough thing to persuade the voters that we are up against limits to the steady increase in material consumption that has become a part of their way of life.

A Stable Society

We may soon have to develop a world culture which emphasizes egalitarianism and non-material concepts of growth; a society that is essentially stable and in which the through-put of energy and materials taken from the earth is minimal and where we recycle, to the fullest possible extent, all of the materials that we consume in the process of conducting our daily life on the planet. But so far almost no technologists have been willing to accept a stable through-put society as a feasible goal for the human race. It is even an anathema to talk about it. The few exceptions are people like E.F. Schumacher, whose Intermediate Technology Organization, located in London, England, designs new types of simple machinery for use in developing countries. A few counter-culture centers espouse the concept of a stable society, along with a small number of liberated young professionals in such fields as economics, political science, and education. But with the kind of world that we have, the power being where it is, I cannot see any hope for a solution to the Malthusian dilemma, and I fear that we are going to end up with a tremendous amount of trouble within your lifetime and mine.

Congressman George E. Brown, Jr., of California, is currently serving his sixth term in the U.S. House of Representatives, Washington, D.C. 20515. He is the chairman of the Technology Assessment Board and a member of the Agriculture Committee and the Science and Technology Committee.

Dilemma 2 — WHO SHALL EAT?

The people of Peleru are very poor. Their daily diets are extremely low in protein. As a result of this protein deficiency many of the people — especially young children and the elderly — suffer from chronic disease and malnutrition. In fact, the death rates for these two groups are among the highest in the world.

Miguel Perez works as Captain of the *Dolphin*, a fishing boat owned by the Costa del Sol Seafood Company in Peleru. All of the anchovies caught by the *Dolphin* are sold to a company in the United States for pet food. Each time the *Dolphin's* storage lockers are filled, Captain Perez sails to Florida and delivers his cargo of fish to the pet food company.

Selling his catch for pet food disturbs Captain Perez because the people of his village in Peleru need the protein-rich fish so badly. After much thought, Captain Perez develops a plan to give part of his catch to the people of his own and nearby villages. In order to carry out the plan, Perez will have to stay out at sea longer to catch enough additional fish. However, he will be overfishing the area and eventually deplete the natural stock of anchovies.

Perez realizes that he is cheating his employer out of profits and using equipment and fuel that doesn't belong to him. He is also aware that he will be contributing to the depletion of anchovies. If he gets caught, he will most certainly lose his job. He feels, however, that since he is a highly trusted employee of the company, he could get away with carrying out the plan.

Should Captain Perez carry out his plan to give away the fish to the people of Peleru? Why or why not?

SAMPLE OPINIONS

David "Of course, Captain Perez should carry out the plan. When human life is at stake people must take action. One wouldn't betray trust and obligation in most cases, but it is sometimes necessary in order to protect life. Here, Perez is trying to do exactly that.

The people of his country have a right to food and good health so company profits become less important in this instance. His own life will have little meaning if he can't do what little he can to help humanity. The injustice is in the fact that some people do not have the opportunity to share in a decent life, and this must be somehow corrected."

Paul "Although Captain Perez does not have the right to go against the company, he is acting on the belief that the people of his village have as much a right to the fish as do cats and dogs. The fish are caught off the country's shores, and the people should benefit from what is rightfully theirs.

As someone who has achieved good fortune, he can do something for his less fortunate countrymen. In this sense he is acting responsibly towards people in great need."

Janet "Captain Perez should not carry out his plan because he will probably be caught. Someone is likely to tell the company, and he and his crew will lose their jobs. He can't risk being branded as a liar and cheat for giving away fish that doesn't belong to him. The company has provided him a good decent living — he can't let the company down.

If he loses his job, what will his own family do? Jobs are hard to come by in a poor country. Although he may feel sorry for people who don't have enough to eat, how can he solve all their problems? Will he be able to supply them with fish forever? The people may become so dependent on him for fish that they wouldn't want to find ways to grow better crops or raise animals."

DISCUSSION QUESTIONS

- What important factors should Captain Perez consider when he makes his decision?
- If Captain Perez were caught and you were the judge presiding over the case, would you punish him? Would your decision be different if you were a resident of Peleru as compared to a resident of the United States? Why or why not?
- How do you feel about people raising pets when people in other countries are starving? Why?
- Is there any other way that Captain Perez can accomplish his goal of feeding his country's poor citizens?
- Does the seafood company have any responsibility to help solve the food problem in Peleru? Why or why not?
- It is justifiable to deplete a species of animal (such as overfishing anchovies) to prevent human starvation? Why or why not?
- If you were in Captain Perez's place, how would you feel about sending your catch of fish to a pet food company in another country? Why?
- What good reasons are there for raising pets? Why?
- Do wealthy countries have any responsibilities to the less fortunate countries in the world? Why or why not?

Can Our Beaches Be Saved?

Reading 1

Are Long Island's Beaches All Washed Up?

by Stephen Darst

Georgica Beach in East Hampton, for decades one of the finest beaches on the south shore of Long Island, has been destroyed in recent months—the victim of God and the U.S. Army Corps of Engineers. Last summer, the beach was several hundred feet wide. Since then, the ocean has carried off not only the beach but part of the asphalt parking lot as well. And it threatens to do far greater damage to houses nearby. Lining the beach near Georgica are the summer houses of some of the wealthiest people in the country—John Olin, of Olin Corporation, William Ford of Detroit, and Pete Peterson, the ex-secretary of commerce. Many of the mansions along the beach, normally valued at $250,000 to $500,000 and upward, are in imminent danger of falling into the Atlantic Ocean, which is beating at their back doors. The house next to the Georgica Beach parking lot, owned by Mrs. Maurice Weigier, of the Wegier Decorating Company family, is poised at the edge of a steep drop-off into the roiling waters of the ocean. Wooden pilings, placed in the water next to the Wegier house as a protection against the waves, have been pounded apart in storms. A local realtor said the house, worth more than $300,000 if not threatened by the sea, would be appraised at "nothing right now," and the East Hampton Village official in charge of beaches said recently that he had warned Mrs. Wegier that her house was "doomed." On the other side of the parking lot, a cottage owned by New York financier Paul E. Manheim is within several inches of the steep drop-off. A few hundred yards past the Weigier home is a house purchased by Mrs. Susan Strausberg, of New York, on February 1. She paid the full pre-beach-erosion price of $250,000. And then the winter storms hit, cutting away the beach in front of the property. The house is now being moved back from the ocean 80 feet, at a cost of well over $50,000. Other

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property owners along the stretch are also talking of retreating from the water.

But the storms of last winter are only part of the beach-erosion problem. Surrounding the nearby beachfront property of Juan T. Trippe, honorary director and founder of Pan American World Airways, are three rock groins, built at a cost of approximately $900,000. (Groins and jetties are the same thing—rock piles jutting out from the shore. Jetties are at inlets, groins on stretches of uninterrupted beach.) The groins, viewed by many as an unqualified ecological menace and a primary cause of the erosion at Georgica Beach and the neighboring properties, protect Trippe's real estate from storms from any direction. The beach in front of Trippe's property is 400 to 500 feet wide and growing.

It was not always that way. In 1958 the Army Corps of Engineers issued a two-volume report recommending the installation of groins and jetties as one weapon for fighting beach erosion from Fire Island to Montauk. There had been some erosion of the beach near Trippe's property, and Trippe and his neighbors pushed for the installation of a 300-foot groin just west of the property. But something went wrong and the erosion near the Trippe land worsened. In 1975 two additional groins, both 650 feet long, were installed, making Trippe's property virtually impregnable to storms and sea currents.

But his neighbor's beach-erosion problems had just begun, and many blamed the groins. When the first one was installed, the beach to the west began to disappear. A house in Wainscott was so threatened by the ocean that its owner, John Nagel, put in a private groin in a effort to rebuild his beach. He was forced to remove the jetty, his house half fell into the ocean and local officials ordered it destroyed.

Although Nagel's go-it-alone groin construction was rejected by local authorities, at least he paid for it. The three groins near Trippe's property have cost him and his neighbors $62,500; the county, state, and federal governments (i.e., the taxpayers) picked up the remainder of the $900,000 tab. Defenders of this public expenditure claim the money was well spent for the benefit of the restoration of the public beach. But the beach between these groins is far to the west of any public parking and is almost totally inaccessible to anyone but the neighboring property owners.

In local parlance, the controversial groins are known as "Juan Trippes's groins," but, of course, they are owned by the federal government, into whose waters they protrude.

According to reports published in *Newsday* several years ago, Trippe lobbied in the corridors of Riverhead and Albany, as well as in Washington, to get the groins built. One rumor had it that the groins were a favor owed Trippe by then Secretary of Defense Robert S. McNamara for help Trippe and Pan American had given the Defense Department in the dewline program. *Newsday* reported that Trippe had given the Suffolk Republican Committee around $1,000 a year for three years prior to 1971, when additional groins for Georgica and Westhampton were proposed in the Suffolk County Legislature—at a cost of $10,030,000.

That bill was defeated and the posibility of additional groins being built now seems dead, although Trippe continues to favor it. That leaves the problem of the damage already done to Georgica by existing groins, and the outlook is bleak.

Bruce Collins, commissioner of public works and highways for East Hampton, feels that all of the houses along the ocean are doomed. "It's only a matter of time. In Georgica I think there will be a long-term problem with erosion. We can't be certain what caused the erosion, but we do know some things. There is some erosion of beach and movement of dunes every year, but in the natural state you don't notice. But if you stabilize a dune by building a house and a driveway and maybe a pool on it, the dune can't retreat as usual, so the foreshore erodes. This has been happening for a long time. These houses have been here for a long time, and now its caught up with us."

Suffolk County Executive John V.N. Klein has "watched what the jetties do and I'm very anti-jetty as a result. In fact, if we had the money, I'd take them out, but it would cost probably twice as much as it cost to put them in. In retrospect, it seems to me that if you put in jetties at all, you have to run them from Montauk to Coney Island. And there isn't enough money in the world for that. We would have been much better off if we had built no jetties and let nature take its course."

In taking that position, Klein said, he is in diametric disagreement with the Suffolk County commissioner of public works, Rudolph M. Kammerer. Commissioner Krammerer, Klein said, is 100 percent pro-jetty and still supports the installation of the proposed additional groins for Westhampton and East Hampton despite the mounting opposition to the groins already there.

"The difficulty is that you have a lot of people like environmentalists and others who get involved who really don't know what they're talking about," Kammerer said. "Engineers like myself and the people at the Army Corps of Engineers have had some experience with this." He thinks that what is needed to halt the erosion at Georgica is "some more groins in that particular area. You need groins in the Georgica Pond area and to the east."

How many groins?

"It all depends. A groin is effective only to about two and a half times its length. And you figure your groin is 500 feet long, so 1,500 feet down the beach you might need another."

But what about the environmentalists' argument that wherever the groin field stops the erosion will begin.?

"That's possible. And it's also not necessarily so. Engineers understand this and enviromentalists don't They are not qualified to talk. And, of course, they get newspaper coverage because it's a controversial thing."

But what of the argument that once you start building jetties you have to run them from Montauk to Sandy Hook?

"That's a possibility," Kammerer said. "I never disagreed with that."

Frazer Dougherty, the owner of a house east of Georgica Beach threatened by erosion, points out that the 1958 Corps of Engineers report called for groin construction only as a last resort. "The engineers proposed a seven-point program," Dougherty says. "The last of the seven points called for jetties if nothing else worked. Well, they built the jetties but never bothered with points one through six—things like nourishing the beach, moving in sand, planting beach grass. I think Mr. Trippe probably said, 'This is an emergency, so build the jetties first.' "

Dougherty is one of the property owners considering moving their houses back. "One of the problems is that the village does not say, 'Look, if you build on the first dune you will have certain problems and you will have to face the consequences.' It isn't proper to build your house on the sand. Isn't that what the Bible says?"

The attitude of village officialdom in the sixties was summed up by then Mayor James Skidmore when he said, "The people who live along that beach pay more than half the taxes, and they can do what they want."

But recently the village has taken a tougher attitude toward beach erosion and the people and things that cause it. Mayor Douglas Dayton has proposed an ordinance, which would require the removal within five years of all jetties, stone walls, and wooden structures along the beach and first dune. Houses would be allowed to stay but without the engineering devices designed to protect them from the ocean. And if the ocean does destroy more than 50 percent of the value of a house, the house cannot be rebuilt on the first dune. Although it was clear at a recent hearing that this stringent proposal has slight chance of passage (it is being redrafted), many local residents welcome the chance to begin serious discussion of the issues centered on Georgica.

If Dayton's proposal gets nowhere, there is always the possibility of lawsuits. Frazier Dougherty says he would be "very interested in participating in a suit to force the removal of the groins. I would like to get groups such as the Sierra Club involved."

In Westhampton Beach, a group of property owners has sued the federal government, asking that either the Corps of Engineers' report be implemented in full or the groins removed. Beach erosion near the groins at Westhampton is even more severe than at East Hampton.

Local wisdom in Suffolk County goes back a long way—back to the mid-seventeenth century, when the forebears of some of the local farmers and fishermen first arrived on Long Island from England—and it has always advised against building near the ocean. "Before the millionaires came in the 1900s, no one would have dreamed of building on the dunes," says Ralph Carpentier, director of the Town Marine Museum. "Building on the ocean and then building the groins to protect you from your first mistake is typical of modern man's thinking about nature. Nature is something to be exploited, we seem to think, not something to work yourself into harmony with."

Natives love to tell stories of people like Dave Garroway, who bought a house in Quogue one day the next day saw it sail into Quatuck Bay during a storm. Or about the McDonnell house in Southampton, the setting for the wedding of Anne McDonnell and Henry Ford, which went into the Atlantic a few years back.

A retired Army Corps of Engineers brigadier general, Clarence A. Renshaw, formerly a pro-groin lobbyist for Trippe, has recently been hired by the beleaguered property owners near Georgica Beach. General Renshaw still believes in the 1958 Corps of Engineers report, including the proposal for groins. The problem, he thinks is not that too much of that report was implemented, but to little.

"Take those big federal groins they've put near Georgica—they're a terrible idea if you don't finish the job," Renshaw told me. "But when you have government bodies involved like the stupid government of this whole general area, all of whom agreed and voted for this project and then refused to appropriate funds to complete it, they have done a tremendous amount of damage. They have placed the owners whose property has been affected in terrible shape."

General Renshaw enunciates the Corps of Engineers' view—that the "protection" of the beach and the oceanfront houses is a proper publicworks project that must be finished. But there is another view. Some argue that building a house at the edge of the ocean is predictably hazardous to house and dune, that beachfront houses should be moved back or left to the mercy of the sea. If there were no houses on the oceanfront the beach could erode and build up, over the years with no loss to anyone. Beachfront houses help cause erosion, ecologists say, and then the problem is compounded by the installation of groins, at public expense, for the false "protection" of private property.

Finishing the 1958 plan would involve filling in sand on the eroded ocean beach with sand dredged from the bay bottoms—a move characterized by Bruce Collins and others as an "ecological disaster." The dredging and dumping would go on forever, Collins argues.

"These people with houses on the ocean are in trouble now," General Renshaw says, "and it's up to everyone to help them within the limits of the law and good judgment. Mr. Trippe called me today and said for me to try to be patient and explain these things to you."

Reading 2

Shoreline Erosion Most Critical In North Atlantic Area[1]

The owner of a beach cottage who nervously watches the barrier of sand between him and the sea grow smaller each year has good reason to be alarmed. Anything he tries to prevent further shoreline erosion is likely to cost him a lot of money and only postpone the inevitable. And the federal government's might has not been much more effective that the private property owner's mite in holding back the waves, according to one participant in a day-long workshop on shoreline erosion held last month at the University of Rhode Island. The meeting, which brought together a panel of experts from various disciplines, was sponsored by Rhode Island's Coastal Resources Management Council.

The beach property owner has plenty of company in his misery. The United States has extensive erosion problems with its 84,000 miles of shoreline, and nature is not going to diminish them in the foreseeable future. John B. McAleer, formerly of the Army Corps of Engineers, described a national study undertaken by the Corps in 1968 at the request of Congress. Its four-volume report showed that excluding the half of our coastline which is in Alaska, 42 per cent is eroding, most critically in the North Atlantic region where population is densest and 85 per cent of the shore is in private ownership.

The long-term rise in sea level, thought to be due to melting of the Antartic ice cap, as well as a possible gradual settling of the coastline itself, are obvious natural causes, but manmade causes loom larger. People, their activities and the structures they erect at the shore have, overall, an unhappy effect on the natural balance between land and sea; so do upstream dams and river regulation, dredging in harbor areas and a host of other activities. And eroding of the shoreline that would go unnoticed in uninhabited stretches becomes painfully obvious when it threatens lives and property.

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[1] This selection is excerpted from *NEMAS Information* #85. The New England Marine Advisory service, University of Rhode Island, June 1976.

In their attempts to protect shorefront property, people are likely to compound the problem. Private owners, McAleer said, often spend large sums of money on "ill-conceived, damaging, badly constructed and short-lived" protection measures. Local, state and even federal projects are frequently doomed too, principally because trying to protect a short reach of beach is almost literally like robbing Peter to pay Paul, and privately owned shorefront, ineligible for federal programs, usually cuts up government holdings. In the long run, land use controls and management at the shoreline are likely to be more effective in saving our coast than any methods engineering has devised, McAleer suggested.

This conclusion was dramatically illustrated by cost figures cited in the Engineers' report. It projected rough, conceptual plans for various mechanical types of shoreline protection, such as sandfill, beach nourishment, groins and revetments. The cost worked out to approximately $1 to 1.5 million per mile or $200 per front foot — an exorbitant amount unless capital-intensive development were planned for the area. Furthermore, McAleer said, individual efforts at protection are likely to be more expensive and legally complex than large-scale programs. Often it is impractical or even impossible to save a single property.

This being so, the study made an effort to assess what extent of erosion was critical, in other words, where remedial measures are justified by loss of life or property. The figure arrived at nationally was roughly 2600 miles, or 7 per cent of the country's total shoreline. However, in New England, the proportion increases to about 13 per cent of the total, some 1100 miles.

Lacking any quick comfort for owners of property at the water's edge, McAleer emphasized that the most useful way to remedy problems is to consider the shoreline in large-scale terms; its long range use, the multiple and often conflicting uses man puts it to, and the protection, by whatever means, of long reaches rather than individual chunks.

Paul Godfrey of the University of Massachusetts spoke from the point of view of a botanist, and his remarks implied good news and bad news. The good news, based on research done at two national seashore barrier beaches, is that nature heals when it is allowed to. All up and down the east coast, he said, one can find evidence of the sea's rise in the last 100 to 150 years — the remains of intertidal salt marshes on what is now beach, the remains of old forests that are now intertidal salt marshes. In effect, the coastline does not vanish, but migrates or rolls over, with ecosystems recovering spontaneously.

Their rate of recovery varies in different localities, depending on the natural vegetation present, but each is adapted to the process. The bad news, of course, involves what man has superimposed on nature — a salt marsh may in time regenerate itself a few hundred yards further inland; a house cannot.

John Jagschitz, assistant professor of plant and soil science at URI, also emphasized nature's capabilities and protection methods based primarily on working with nature. He described devices tested by the University that have proved useful, such as using brush piles or snow fences to cut down sand transport by the wind, and the stabilization of dunes through planting of beach grass. Needed research that he cited was mainly in refining the method, learning when to plant, and developing reliable sources of plant materials.

Dr. Robert McMaster, State Geologist for Marine Affairs and professor of oceanography at URI, narrowed the perspective to describe what has been happening to Rhode Island beaches between Watch Hill and Matunuck and to explain the natural and human causes. Composed of glacial material, which makes for a very irregular shoreline, southern Rhode Island beaches are particularly susceptible to wave action. Studies of maps dating back to 1838 suggest that until 1909 the shoreline was building out in this area, but since then the beaches have been regressing at a rate of about five feet a year. The loss was accelerated at Matunuck Point where 500 feet of beach have disappeared since the completion of Point Judith's Harbor of Refuge in 1914. Since 1961, annual surveys of Weekapaug, Moonstone, Green Hill and Matunuck Point beaches show that regression is continuing, and an ongoing computerized program helps pinpoint concentrations of wave energy as well as low energy areas.

Two things can happen to a barrier beach, McMaster pointed out, underscoring the inevitability of natural process: it can grow in height and stay in the same place, though rising sea level will require the addition of more and more sand for this, or it can migrate landward, which is what is happening here.

The steps that lead to shoreline protection or restoration are not ones that can be taken overnight. Congress gave responsibility for the work to the Army Corps of Engineers (Civil Works Division). But before this body takes any action, a local or state government has to advise its Congressman of the problem and, if it secures his agreement, wait for a Corps study of economic feasibility. If this hurdle is passed, the Corps recommends solutions to Congress, as well as the opinions of local government. With luck, this results in a Congressional appropriation of funds to do the work. Cost is shared on the basis of ownership of the threatened area. The federal government will pay the whole bill for federally owned land, 70 per cent of the cost for publicly owned recreational property and 50 per cent for publicly owned property not used for recreation. It will also ante up to repair erosion contributed to by federal navigation projects. However, the federal government will pay no part of the cost or restoring privately owned shorefront. This, as John McAleer pointed out, has much to do with our shoreline problems. Only 11 per cent of the coast belongs to the federal government; 70 per cent nationally is in private ownership.

Mindful of this, Congress in 1974 created the Shoreline Erosion Advisory Panel, composed of 15 non-government people, to advise private landowners on low-cost protection methods and ways of dealing with minor erosion problems. The group is also one of three advisory agencies which work with the Corps of Engineers, Joseph M. Caldwell, its chairman, explained.

Congress has further authorized the panel to spend $8 million over the next five years to test low-cost protection methods and set up demonstration sites nationally. Around two hundred sites have been suggested, 60 of them along the east coast, but in the end, Caldwell said, two will probably be chosen for each coast. The kind of remedies for which the panel is searching are geared to individuals — steps that could be taken by a property owner himself at a cost of $50 a front foot or by a contractor for no more than $125.

However, Caldwell emphasized that planning and group effort will give better and cheaper results. "Find a logical start and stop," he said, "and get everyone in a threatened sector to work together. You'll get out much cheaper that way than if you just worry about yourself and forget your neighbors."

Dilemma 3 — CAN OUR BEACHES BE SAVED?

The town of Ocean View is a seashore community on the North Atlantic coast. Although most of the beachfront property in Ocean View is privately owned, one narrow strip at the north end of town has been set aside as a public bathing beach. In recent years Ocean View's beaches have been eroding at a rapid rate, and nearly all of the homes built on the sand dunes along the beach have been threatened.

The problem has suddenly become critical because severe storms for the last two winters have sent waves crashing across the beach and into the dunes. As the waves retreated, they removed large quantities of sand, including sand from beneath the foundation walls of homes perched on the dunes. So far, one house has toppled off the dune, and thirty additional houses are in danger of being destroyed.

The land owners of Ocean View whose oceanfront homes are in danger have asked the governor to use public funds to build a set of groins at Ocean View to trap sand coming from the south. This they feel will help to stabilize and even help to rebuild the beaches.

The other residents of Ocean View have signed a petition insisting that the governor leave the beaches in their natural state. They argue that these publicly funded groins will only benefit private landowners who were foolish enough to build homes on the unstable sand dunes. Furthermore, the groins will starve the shrinking bathing beach to the north and eliminate the one remaining beach in Ocean View still open to the public.

Should the governor authorize the construction of the groins? Why or why not?

SAMPLE OPINIONS

Jill "No. I think it is time that people and government develop a more sensible attitude towards our natural environment. By trying to correct our past mistakes, we will continue to add to our future problems with beach erosion. We can't build groins and jetties forever. In a sense, controlling a natural process to satisfy our whim to have a beach in a certain place is a mistake. It's reinforcing people's selfish notion that nature was created for us to exploit. We must begin to understand the delicate and sensitive workings of nature and by doing so can better enjoy what nature has to offer.

Perhaps, refusing to build the groin is taking a stand against building on beaches. In the long run we all may have more beaches for recreation and pleasure."

Mark "Yes. The governor must recognize the importance of the beach to communities that are built along the beachfront. If it weren't for the beach, the community wouldn't be there.

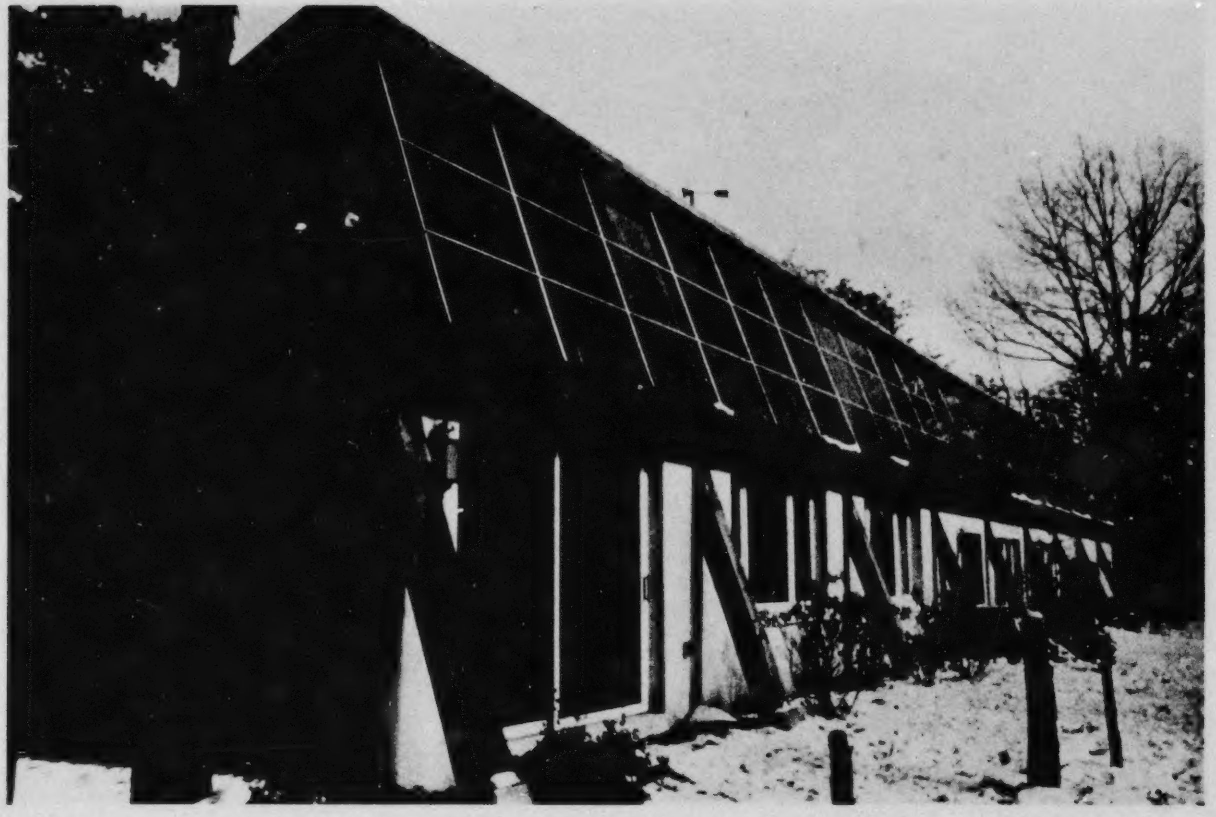
Government should respond to this disaster as it does in other type of natural disasters — floods, hurricanes, droughts and so on. It has a duty to protect existing communities by safeguarding property and providing aid in times of disaster. Anyway, the problem of sand loss to the north of Ocean View can be easily solved by building another groin."

Paul "No. How can the governor justify committing such a large sum of state funds to protect a few homes? Besides, building the groins could damage the one remaining public beach to the north. The governor has to recognize the importance of that beach to people who want to enjoy the seashore but can't afford to own beach houses.

People who build houses on the dunes are doing so at their own risk. They should know that nature is unpredictable. Anyway, they can't ask the public to finance a project for their own benefit. That's unfair."

DISCUSSION QUESTIONS

- In making his decision what important factors should the governor take into consideration? Why?
- If the government builds dams and dikes to prevent floods, why shouldn't it also build groins and jetties to keep beaches and waterfront houses from washing away?
- Should the government spend so much money to build groins to protect beaches when only a few people benefit? Why or why not?
- If you owned a home that was threatened by beach erosion, would you expect the government to help control the danger? Why or why not? What if you were in a flood prone area? Why or why not?
- A person building a groin to protect his property would be diverting ocean wave action and could cause erosion of his/her neighbor's beach. Should he/she be allowed to build the groin? Why or why not?
- The very existence of most beach communities depends on keeping the beaches intact. Isn't that reason enough to protect beaches from washing away? Why or why not?
- If beaches are so unstable, should all building along the beaches be outlawed? Why or why not?
- Should people try to change the course of nature, such as restoring beaches? Why or why not? Would you want to prevent destruction of a beach that is a popular public recreational park (e.g., Sandy Hook National Park)?



Please Don’t Take My Sunshine Away

Reading 1

Law: Protecting A Place In The Sun

by Arnold W. Reitze, Jr. and Glenn L. Reitze

Protecting access to sunlight for purposes of solar heating and power generation is a subject awash with unsettled legal questions. Their resolution is important not only to protect present solar facilities but, more importantly, to encourage more widespread use of solar-powered systems.

The potential legal problems range from the natural growth of a neighbor's tree so that it blocks a solar collector to the provisions of building codes controlling any type of construction, including new solar collectors. There are also problems of property taxation and mortgage applications, potential inter-union jurisdictional disputes over solar-system construction, problems of aesthetics, and perhaps even "light pollution" from bothersome solar equipment. Identifying the problems in advance and finding the answers to them are not simple tasks. Nevertheless, there is a surprisingly rich history of possibly applicable legal precedent and analogy in this country and abroad.

Basically, sunlight can be considered legally either as a resource or as an intermittent aspect of the property that it strikes. Although the former legal interpretation offers many fine possibilities for new legislation, it is the latter concept that has dominated legal thinking about sunlight. Legal protection of property access (specifically for windows) to daylight has been possible in the Anglo-American world at least since 1611, when an English court decided *William Alfred's Case* (9 Co. Rep. 57b). The legal theory on which this protection was and can still be based was that of the existence of an easement.

An easement, defined very loosely, is a right held by one property owner in relation to the owner of a neighboring parcel of land. For instance, an easement may exist as a right of access across another's land to a parcel of land which otherwise could not be reached by

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[1]Reprinted by permission from ENVIRONMENT, Vol. 18, No. 5, June 1976, pp. 2, 3.

surface travel. There are other types of easements; the subject is a complex one and is the topic of many books and scores of articles in legal journals. Some authors distinguish easements from rights-of-way and quasi-easements, and although American law on the subject stems from English law, the common and statutory laws of the two countries differ significantly. Nevertheless, a glance at the English law provides a useful comparison.

In English law, an easement to daylight (*not* to direct sunlight per se or even to light reflected by a specific surface) is possible under the Prescription Act of 1832, which codified the basic common law rule on the subject. Section 3 of that act specifically recognizes the legal existence of an easement "when the access and use of light . . . shall have been actually enjoyed therewith for the full period of twenty years without interruption. . . ." Anstey and Chavasse, authors of a slim volume entitled *The Right to Light*, which was published in the 1950s in Britain, comment that such an "easement of light will not arise unless there is an actual building and a defined aperture intended for the admission of light," and they add that the complainant must show that he or she actually *used* the light from the affected window.

Obviously, this particular application of the principle of an easement for light is not a panacea. Yet the twenty-year rule is just a part of the problem. As mentioned, easements to direct sunlight as such simply are not recognized under the British rule, nor has there existed any traditional right to a *view*. Furthermore, this English law does not recognize any absolute right to *all* of the light formerly received at the window. Traditionally, one's neighbor could block off about half the previous light or enough so that there was no violation of the "grumble test," which was no more scientific than its name suggests: In short, jurors were asked to visit the premises and to decide from their personal inspection whether the average person within the affected room would "grumble" about the lack of light. Primitive, yes — but finding a better test than this has not been easy.

In the U.S., easements and similar provisions for protection of access to light also have possible application, although the common law easement arising from customary practice over twenty years has been eliminated by statute in some states. In contrast to England, easements to light in the U.S. can be created in various ways through specific agreements, some viable only between specific property owners and others legally "attached" to the property itself. Basically, mere agreement of the affected owner (the one who is to be required to permit the access of light to his neighbor's property) is all that is required, with payment of some sort for the right. Readers who are interested in this aspect are referred to the dissertation at 142 *American Law Reports Annonated*, pages 467 to 485, a legal encyclopedia found in most large law libraries.

The more significant controls of access to light in the U.S. stem from the complexes of local regulations comprised of building codes, height regulations, setback provisions, and general zoning patterns. These have been effectively shaping our cities since the beginning of the twentieth century, and most such provisions were already well-established law by 1926, when the U.S. Supreme Court, in *Village of Euclid, Ohio v. Ambler Realty Co.* (272 U.S. 365), resoundingly affirmed the constitutionality of zoning ordinances per se. In *Euclid*, the court had this to say in regard to building codes and light:

". . . in some sections the apartment house is a mere parasite, constructed to take advantage of the open spaces and attractive surroundings created by the [single-family, detached homes] residential character of the district. Moreover, the coming of one apartment house is followed by others, interfering by their height and bulk with the free circulation of air *and monopolizing the rays of the sun* which otherwise would fall upon the smaller homes. . . ." (Emphasis added.)

This landmark case, while showing an antiquated and class-biased view of apartment houses, was significant in its recognition of the role of sunlight in building restrictions. To this day, the courts recognize the dual nature of height regulations as a restriction on density as well as a device to protect access to light and air. Sunlight in the U.S. has generally been considered a health benefit, and access to it has been legally regulated to protect the general health and welfare of the public. But economic considerations certainly have not been absent from the courts' rulings.

When such provisions of local building and zoning laws have not protected a property owner's access to all of the natural light to which he or she felt entitled, resort to a lawsuit on nuisance or other tort (civil wrong) grounds has frequently been attempted, occasionally with success. A classic Latin maxim quoted repeatedly by the courts is *sic utere tuo ut alienum non laedas* (therefore use your own property so as not to harm that of another). This concept forms the basis for much of the government's regulatory power as well as for civil suits against neighboring property owners. One example of such a suit is the "spite fence" case. This type of case is based on the ancient rule that the erection of a construction — typically a fence — for the sole purpose of adversely affecting a neighbor's property is not permitted. Nevertheless, because of problems of proof, the fencebuilder usually wins. An example is a well-known 1912 case tried before the Supreme Court of Alabama involving a complaint about the owner of a vacant lot in a residential neighborhood who erected a twenty-foot-high board fence on the edge of his property, preventing daylight from entering a neighboring house. The plaintiff claimed the fence had been erected solely to vex and annoy him, as the fence served no purpose. But the court ruled that the contention that the fence was useless was not sufficient in itself to prove that the fence had been erected only for a malicious purpose.

The "spite fence" doctrine remains active in local courts, and multi-million-dollar suits are sometimes involved. An important 1959 case was *Fontainebleau Hotel Corp.* v. *Forty-Five Twenty-Five, Inc.*, in which it was alleged that a fourteen-story addition to the Fontainebleau Hotel in Miami Beach was being erected on the north side of the hotel rather than on the south side simply to prevent sunlight from striking the pool and sunbathing areas of the neighboring Eden Roc Hotel.

The Florida court rejected the claim, writing that:

"This is indeed a novel application of the maxim *sic utere tuo ut alienum non laedas*. The maxim does not mean that one must never use his own property in such a way as to do any injury to his neighbor. . . . It means only that one must use his property so as not to injure the lawful *rights* of another.

"No American decision has been cited, and independent research has revealed none, in which it has been held that — in the absence of some contractual or statutory obligation — a landowner has a legal right to the free flow of light and air across the adjoining land of his neighbor. Even at common law, the landowner had no legal right, in the absence of an easement or uninterrupted use and enjoyment for a period of twenty years, to unobstructed light and air from adjoining land. . . . And the English doctrine of 'ancient lights' has been unanimously repudiated in this country. . . .

"There being, then, no legal right to the free flow of light and air from the adjoining land, it is universally held that where a structure serves a useful and beneficial purpose, it does not give rise to a cause of action . . . even though it causes injury to another by cutting off the light and air . . . regardless of the fact that the structure may have been erected partly for spite."

This roughly sums up the status of American law today in regard to sun rights, with the minor exceptions of statutory mentions in Oregon and Colorado. These will be discussed in the next issue of *Environment*, along with some new theoretical approaches to the problem and an analysis of proposed "model laws." New methods and approaches are obviously needed.

Reading 2

The Sun In A Drawer

by Bruce Anderson

Widespread use of solar energy for heating and cooling buildings requires the solution of a number of problems other than those associated with the technical aspects of building and maintaining the systems. In fact, many of the technical problems have already been solved (see "Solar Energy," *Environment*, June 1973), but nontechnical difficulties persist. The basic difficulty is that extensive use of solar energy requires large-scale integration of new solar energy systems, ranging from specific solar components to properly designed buildings, into a complex of existing regulations which includes building mortgage criteria, property tax laws, building code standards, manufacturing restraints, construction methods, and labor requirements. The institutions responsible for the constraints are generally quite conservative and so far have not made major concessions to the concept of solar energy as an alternative power source. However, with the costs of conventional fuel rising, and with local and federal governmental agencies becoming involved with promotion of solar energy for heating and cooling, the stage appears to be set for very rapid development of this neglected source of power for basic building needs.

An indication of this potential is that the number of buildings using, or planning to use, solar power in the U.S. has risen in the past two years from a mere handful to several thousand. Rays from the sun are being used for energy in government buildings, schools, private homes, environmental institutions, and commercial establishments. Based on traditional economic criteria, the cost of solar energy now often competes with that of fossil fuels for the heating of buildings and water.

School buildings are particularly good structures for the application of solar energy. In January 1974, in an

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[1] Reprinted by permission from ENVIRONMENT, Vol. 17, No. 7, October 1975, pp. 36-41.

effort to speed promotion of the use of solar energy, and to show Congress some immediate results, the National Science Foundation (NSF) awarded four contracts for the construction of experimental solar heating systems in a high school, two junior high schools, and an elementary school. The program, called "Solar Energy — School Heating Augmentation Experiments," is aimed "at advancing the systems technology for using solar energy for space heating and hot water needs of buildings, and to provide important information on the degree to which such systems can be made economically justifiable and socially acceptable."[1]

Refitting existing buildings with new solar equipment, as was done with the four NSF-funded school projects, is one of the most practical and important applications of solar heating. In many existing buildings, it is easier to reduce fuel consumption by adding solar heating systems than by adding insulation to the walls and roofs. Solar collectors can be attached to walls, installed on rooftops or placed in separate housings on the ground next to the buildings.

One of the oldest operating solar-powered buildings is a house located near the campus of the University of Florida in Gainesville. It was built in 1955 by members of the university's Mechanical Engineering Department for the purpose of measuring heat flow into and out of a home. In 1968, the house was refitted for conversion to solar heating. Power from the sun is now being used to heat the house, its water, and its swimming pool and to actuate its liquid-waste recycling system, which operates through water distillation. Solar energy also partially powers an electric conversion system for television, lights, radios, and small appliances in the house, and a solar-electric car. Solar air conditioning and refrigeration for the home are being installed.

Financing Difficulties

One difficulty in providing solar energy systems for private homes is that most people prefer to have complete solar heating or cooling systems rather than systems which supplement existing heating or cooling systems. But systems which provide 100 percent solar power are usually far too large and costly to be practical; provision of solar energy for 50 to 75 percent of heating needs is a more realistic goal for most buildings in most parts of the country.

Another problem facing the individual homeowner is that the initial cost of a solar system is usually higher than that of a conventional system. Home financing plans are not usually designed to encourage such an investment even though lower heating bills over the lifetime of the system make it a sound buy. Financial institutions could ease the difficulty by taking into account the long-term benefits of solar energy resulting from lower operating and maintenance costs. At present, these institutions are instead inclined to concentrate on initial installation costs. It is hoped that the increasing costs of conventional fuels will cause changes in lending policies.

Many cost analyses have been done comparing the use of solar energy with the use of fossil fuels. George Löf of Colorado State University and Richard Tybout of Ohio State University have carried out some of the most extensive studies in this area.[2] Their results are promising (see Table 1). In their calculations, the original investment cost for solar energy system equipment was amortized over a twenty-year period at 6 percent interest. In the seven U.S. cities studied, projected solar heating costs were lower than the costs of electric heating and, in some cases, lower than gas heating costs. Although the study cited here uses reliable comparisons based on present fuel costs, fuel prices are likely to rise unpredictably, a factor which may alter the results of the study.

Other cost-estimate studies, which take into account equipment costs only, have had varied results. Erich Farber, head of the solar energy group of the University of Florida's Mechanical Engineering Department and one of the world's leading authorities on solar energy, estimates that equipment for his system for total solar heating and cooling of a house in Florida would cost about $5,000 more than conventional equipment. On the other hand, another expert in the field, Harold Hay, estimates that new equipment for the use of his flat water-bed-type collector on his totally solar-heated and -cooled house in Atascadero, California, would cost no more than the furnace and air-conditioning system it replaces.

Traditionally, housing developers have been interested in keeping costs as low as possible, a goal frequently incompatible with comprehensive solar energy systems. However, developers, too, may have difficulty in obtaining gas and oil for new houses in the future; it would be to their advantage to consider alternative sources of energy.

Those elderly people who can afford the high initial investment of buying a house, but would like to be assured that their fixed retirement income will not be eaten up by increasing fuel bills, may find that solar energy can provide a solution for this problem. Amortization of the cost of solar energy equipment along with the cost of the home could assure relatively stable future heating and cooling expenses.

Another financial consideration is that the extra employment stimulated by the development of the use of solar energy can be a boon to local economies. For example, most of the gas and oil used for heating in New England is shipped there from other regions of the country or is imported. Annual cash outflow for this purpose amounts to billions of dollars and is increasing every year. Materials such as glass for solar panels are likely to be manufactured in the U.S.; these components are inexpensive to produce but costly to transport, a factor which will make local assembly practical, thus diverting money from foreign markets to local economies. Furthermore, installation of the manufactured equipment would utilize local labor.

Tax Incentives

Since real estate taxes are based on property values, higher initial property costs result in higher taxes. Lowering these taxes to encourage the use of solar energy in homes and other buildings is a desirable goal, but assessment of property taxes is often locally controlled, and change in this area is difficult.

Other incentives for solar energy systems, now un-

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der consideration by the federal government, are low-interest, government-subsidized loans. These loans could be made both to building owners and to manufacturers. The Department of Housing and Urban Development is developing interim solar energy design criteria for homes financed by the Federal Housing Administration and may insure home-improvement loans for the installation of solar energy in existing homes. Income tax write-offs for solar-powered systems are also being considered in Congress. Such deductions would be based on a percentage of the installation cost of the system or of the energy savings made possible by the system.

Design and Manufacture

One of the main difficulties in the design, manufacture, and marketing of solar systems is the necessary combination of good performance, long-lasting materials, and economy of operation. The designer must have a sophisticated understanding of the workings of solar energy in order to avoid the pitfalls which have been discovered in the past. In most instances, the system's design must fit into the design of an existing building. The necessary research and testing are expensive and arduous, and many architectural and engineering firms hesitate to invest extra time and money in the design of solar systems and buildings. Those firms which do take on such projects often find it practical to delay the selection of components until the last possible moment, since new technology is constantly being developed, and increasing mass production of components is bringing costs down.

Manufacturers are moving more quickly to close the present gap between the availability of finished solar components and the demand for them. There are at least 50 manufacturers seriously involved in these developments and several hundred others who are carefully noting the increasing demand for solar energy, keying their investments in solar component production to the market. The existing market, however, is fragmented, and new markets need to be developed. Manufacturers are understandably reluctant to tool up assembly lines before an adequate popular demand develops, but this kind of development is not likely to take place until high-quality solar collectors are made available for sale at reasonable prices.

Agencies with the funding power necessary to promote solar energy design, such as the NSF and the Energy Research and Development Administration (ERDA), are spending little to train the needed contractors and technicians. This reluctance adds to the shortages found by interested designers and manufacturers in their efforts to develop a solar energy industry.

Organizations are now being formed to aid manufacturers interested in solar energy. The Solar Energy Industries Association, comprised primarily of manufacturers, was organized in 1973 to "stimulate prompt, orderly, widespread, and open growth of economic utilization of solar energy." It was formed in conjunction with the Washington, D.C.-based Solar Energy Research and Information Center, a "specialty service organization devoted exclusively to assisting persons, companies, governments, associations, and other organizations" in promoting the use of solar energy. This organization publishes two bi-weekly newsletters, the "Solar Energy Washington Letter" and the "Solar Energy Industry Report." Other services offered are "legislative and regulatory liaison, special reports, and consulting."

Construction Barriers

There are several other potential problems centered in the housing construction industry and in the laws which regulate it. The industry has a record of excruciatingly slow adaption to change, particularly when change means higher construction costs. There are thousands of builders; thus, the industry is highly fragmented, with 90 percent of all construction work done by companies which produce fewer than 100 units each per year. Even the largest building concerns each produce less than 0.5 percent of all housing units. The profit margin in this industry is already small, and innovation in a first-cost-oriented industry such as solar heating and cooling is a risk which few builders will take. Fortunately, the use of solar energy is being tried by some contractors and developers to evoke interest in new housing developments, an effort which may bring increased sales during recessionary periods.

Building codes are designed both for safety and business purposes. There are presently about 30,000 different building code jurisidictions in the U.S.; many of which have mutually incompatible requirements. Fire codes are the ones most likely to affect the implementation of solar energy; these codes are relevant to three of the components in solar energy systems. One is the heat storage system. Paraffin is a good heat storage material for possible use in these systems. As it melts, paraffin stores large amounts of heat, and it releases that heat as it solidfies. However, because of paraffin's flammability, some fire codes may not allow the substance to be used inside buildings.

A second component subject to fire code regulations is the solar collector cover plate. Unbreakable plastics and fiberglass are alternatives to glass for use in cover plates; such products are generally less smoke- and fire-resistant than glass, but since the cover plates are installed on the outsides of buildings, the problem would only present itself in the case of external fires.

The third component to consider in regard to fire codes is the material used for insulation on the back sides of solar collectors. Insulation materials include fiber glass, polystyrene, and polyurethane. All insulation materials are generally in relatively close contact with the solar absorber plate, which can reach temperatures above 350 degrees F., and many materials can melt or smoke at these high temperatures. Insulation should thus be separated from the absorber plate by at least a three-quarter-inch air space and should be faced with reflective foil.

Health codes must also be considered. These codes can apply when ethylene glycol (mixed with water to prevent freezing) is used as a heat transfer medium. This chemical can contaminate drinking water, and precautions must be taken to insure that leaks in the system are avoided.

Still other building codes may limit the use of solar energy. A height restriction for buildings in one area along the shoreline in Long Island Sound in Connecticut has resulted in an unfamiliar but pleasant building design for a solar home. This three-bedroom, year-round residence, completed in 1974, was designed to obtain 60 percent of its heating energy requirements from a modular flat-plate collector system designed by Everett Barber, Jr., and sold by Sunworks, Incorporated. The system was estimated to cost $3,500 more than a conventional heating system, but it has cut fuel costs from $600 to $300 per year. Zoning height limitations required that the roof be low; therefore, the three south-facing collectors are arrayed in a sawtooth fashion, an arrangement which also provides clerestory lighting for the interior of the home. The total area of the solar panels is about 20 percent of the home's 1,900 square feet of living area. Other energy-saving features in addition to the solar heating system include the sizing and placement of windows to provide for maximum natural daylight and ventilation. The overhangs above the large window areas reduce the sun's heat in the summer, but are built at an angle which allows the sun's rays to penetrate the house during the winter. Solar air conditioning will be installed in the house in the future.

Sun Rights

Architectural agreements allowing for unobstructed exposure to the sun's rays may be necessary as more buildings begin to rely on solar radiation as their source of energy. Legislative steps may have to be taken to guarantee that neighboring construction and vegetation does not reduce the amount of solar energy which strikes a particular building. California is presently leading the country in attempting to provide "sun rights" through legislative action. Until such laws are enacted, however, the use of solar energy may be subject to interference from new buildings or from shade trees.

An example of the importance of sun rights is shown in the design development of SolarCon Center, a $48-million project comprised of a 28-story office condominium and a 22-story professional building. It is being designed by the Messineo Financial Corporation of Pasadena, California. At first, solar collectors were to be installed on the south wall of the tallest building, but the unresolved threat of possible shadowing by adjacent construction led to a rooftop collector design.

The possibility of vandalism of the transparent cover plates of solar collectors has been of great concern to designers and potential buyers of solar buildings. However, over the 30-year history of the use of solar energy in the U.S., which saw the completion of approximately 25 solar energy projects prior to 1965, vandalism has not been a problem. Other all-glass buildings have likewise experienced relatively minor difficulties with vandalism.

Another inherent drawback which has concerned designers is that the sun's reflection from large expanses of glass-covered collectors may affect pedestrians, drivers, and people in nearby buildings. However, except in rare cases, the expanse of solar collectors will not nearly approach the large expanses of some all-glass buildings. Glare from such buildings has not usually been found dangerous; in most cases, the effect is not as severe as that experienced when driving directly into the sunrise or sunset.

The Future

In looking ahead, it appears that the use of solar energy for heating and cooling will probably have quickest acceptance where climates are sunny and temperate, permitting the application of solar energy during a large part of the year, and when conventional fuel costs are as high or higher than the cost of using solar energy. Solar heating can also be used effectively in areas where the winters are long and cold, but sunny, as these areas have a great demand for heating fuel and have adequate sunlight for optimal use of solar energy.

The coordination of supplemental services by gas and electric utility companies will be increasingly important as solar buildings increase in number. For most solar designs, the peak demand on the utilities will occur after several sunless days. This demand would be intensified if there were a corresponding peak demand on the utilities by other customers in the service territory. Thus, not only would the homeowner be required to install a full-sized non-solar back-up system, but the utility companies would have to have extra generating capacity to meet occasional peaks. In the past six to twelve months, utility companies across the country, along with several federal agencies, have shown an increased inclination to search for solutions to this future dilemma. The NSF, ERDA, the Federal Energy Administration, and the Electric Power Research Institute are all funding research studies related to the problem.

Another important consideration is that the use of energy for space heating, hot water, refrigeration, and air conditioning accounted for 11.5 percent of total energy consumption in the U.S. in 1968. What is more impressive, these applications consumed 28 percent of the energy used for industrial purposes and 76 percent of the total energy used by all commercial enterprises.

Wide press coverage and greatly increased governmental legislation and funding indicate that, as interest continues to develop, millions of people will be participating in the use of solar energy. It is possible that future use will exceed even the most optimistic predictions of the speed with which solar energy will reduce the need for consumption of other forms of energy.

The title of this article as originally submitted was "Here Comes the Sun." The Publisher and Editors of Environment are responsible for the published titles and subtitles, selection of photographs and lead-in excerpts, photo captions, and preparation of most graphs and illustrations which appear in Environment articles.

NOTES

1. National Science Foundation news release, Feb. 1974.
2. Tybout, Richard A., and George O. Löf, "Solar House Heating," Nat. Resources Jour., 10(2):268-326, Apr. 1970; Löf, George O. G., and R. A. Tybout, "Cost of House Heating with Solar Energy," Solar Energy, 14:253-277, 1973; Löf, George O. G., and R. A. Tybout, "The Design and Construction of Optimized Systems for Residential Heating and Cooling by Solar Energy," Solar Energy, 16:9-18, Aug. 1974.
3. For two such sources, contact Edmund Scientific Co., Barrington, N.J., and Zomeworks Corporation, Albuquerque, N.M.

Dilemma 4 — PLEASE DON'T TAKE MY SUNSHINE AWAY

The experience of a winter fuel shortage caused the Blake family increasing alarm. They felt that the shortage was the result of people wastefully using energy. Mr. Blake especially felt an urgent need to contribute to conservation efforts and preserve fossil fuel resources for future generations.

After much debate, the Blakes decided to borrow $10,000 and install a solar heating and hot water system in their home. Within a few weeks the solar collector was installed on the roof of their house, and the Blake family began enjoying the benefits of lower fuel bills and the knowledge that they were helping to conserve non-renewable resources.

Next door live the Fishers, a family with six children. Adam Fisher owned one of the two small grocery stores in town and earned barely enough to make ends meet. Although he would like to move his family into a house with more bedrooms, he simply could not afford to do so. Since the small size of the lot made ground level extension impossible, the Fishers decided to add a second story to solve the problem of cramped living space. A remodeling permit was obtained, and Adam Fisher, with the help of his two teenage sons, began construction.

When Martin Blake saw the activity next door, he knew that the added second floor would block the sunlight to his solar collector. He proceeded next door to talk to Adam Fisher and request that he halt construction. Adam Fisher refused, stating that the additional rooms were vitally needed, and he should be able to build whatever he wanted on his property as long as it met the zoning codes of the town.

Since Adam Fisher could not be persuaded, Martin Blake thought about forming a large group of friends and other owners of solar collectors to boycott and picket the Fisher grocery store. A boycott by 25% of the town people would literally force Mr. Fisher out of business within a few months.

Should Martin Blake start a boycott of the Fisher grocery store? Why or why not?

SAMPLE OPINIONS

Bill "No. I think that it will be wrong for Martin Blake to organize the boycott. Even though Mr. Fisher is being unreasonable and will not change his building plans, boycotting the store is spiteful action to take. Martin is really taking the law into his own hands. He should recognize that Mr. Fisher has a right to build on his own property. Mr. Fisher hasn't harmed or injured anyone. All he wants to do is to provide a comfortable home for his family, and he has every right to do so."

Phyllis "This is not the kind of action one should take against one's neighbors. The Fishers would lose everything if the boycott were successful. Mr. Blake should show some concern over the welfare of his neighbors.

The townspeople would probably be horrified to see a respectable man such as Mr. Fisher put out of business. The boycott would also disrupt the peaceful, friendly atmosphere of the town. Who would want to live in a town where neighbors fight with one another?"

Richard "Yes, if Martin Blake starts a boycott, he will be pointing out the need for new building laws. People who put up solar collectors should have a guarantee that they will always have access to sunlight. If people don't have this promise, they wouldn't be willing to undertake such a big project. With our energy problems becoming more critical, it is urgent that more people use fuel saving systems. Energy conservation should be the responsibility of everyone in the community. This is the point Martin is trying to make.

Also, Martin Blake had the solar collector up before the Fishers put up their second floor. In this case Adam Fisher is in the wrong because he's robbing the Blake's of their share of sunlight. Martin is certainly justified in trying to protect his rights. His action may very well lead to laws that protect people's basic right to sunshine."

DISCUSSION QUESTIONS

- Since there are no laws preventing the Fishers from building an addition, why should they not build? Shouldn't everyone have the right to do what they want on their own property? Why or why not?
- What is the reason for one to own property if one cannot use it as one pleases?
- Is the right to build on one's own property more valuable to society than the right to receive sunshine? Why or why not?
- Would the community benefit in any way if Mr. Fisher were prevented from constructing the second story of his house? Why or why not?
- If the solar collector cost less ($100 for instance), should that make any difference in Martin Blake's decision? Why or why not?
- If you were one of Martin Blake's friend, would you join in the boycott of the Fisher market? Why or why not?
- If you were one of the six Fisher children, would you sacrifice the comfort of a large house so that others can save energy? Why or why not?
- If Martin Blake's boycott were successful, Mr. Fisher would lose his business. Do you think that a person with a conscience would be bothered by this? Why or why not?
- With fossil fuel becoming more and more a scarce resource, shouldn't everyone do his or her part to save energy if it means giving up certain basic rights such as developing private property? Why or why not?

What You Don't See Can Hurt You

Reading

Microwaves: The Silent Invaders

by Irwin B. Arieff

Few reporters attended the meeting of the federal Electromagnetic Radiation Advisory Council held in the New Executive Office Building, directly across from the White House, February 9 - 10. It was not the kind of event Washington's news-gathers normally notice. And though the meeting was open to the public, it is doubtful that anyone who might have wandered in would have wanted to stay. The presentations droned on from 9 a.m. till 6 p.m., and the illustrations projected onto the screen set up at the front of the room consisted largely of graphs featuring "log S," "megaherz," and "milliwatts." It was, in fact, difficult to believe that this room full of scientists, physicians, bureaucrats and military men was discussing an almost totally unexplored, yet frighteningly pervasive threat to human health: the microwave.

Microwaves form the basis of much of the nation's sophisticated communications technology. The term applies to a large family of small bandwidth electromagnetic energy forces; nearly 250,000 telephone and television signal relay towers emit microwaves, as do approximately 1000 television stations 121 million TV sets, nearly 8000 AM and FM radio stations, a rapidly growing number of industrial and consumer appliances (the best known being the microwave oven) and an unknown number of military, governmental and business communications systems.

At low power levels (such as those broadcast by two-way radios) or when channelled in precisely aimed beams (such as those transmitted by telephone communications systems), the effect of microwaves on humans is practically nil. But when randomly dispersed by powerful television and radio transmitters, microwaves may be capable of causing bizarre emotional and physical ills — health hazards the government and

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the public are only just now beginning to understand.

Microwaves have been in use since the 1930s. Scientists have always known that microwaves — through their heat-generating capabilities — could hurt humans exposed to high levels of microwave energy; this was the principal that led to development of the microwave oven. But it has only been over the past decade that researchers in the U.S. have recognized that much lower levels of microwave energy can affect the body, especially when exposure is constant and for long periods of time.

While the U.S. government has largely ignored the implications of these findings, the U.S.S.R. started 25 years ago to restrict worker exposure to low-level microwave energy. Among the symptoms of microwave poisoning recognized in the U.S.S.R. and other eastern European countries are dizziness, irritability, depression and emotional instability.

Failure to take action in this country can be attributed to a number of factors, not least among them the Pentagon's fear that strict microwave safety standards might hamper national security measures. In any event, both industry and the government agreed to a voluntary safety standard in the 1950s that is 1000 times higher than the level accepted as safe in Russia. Certified by the American National Standard Institute, the standard was set at an exposure of 10 milliwatts per square centimeter, based on the belief that the sole danger posed by microwaves was that of excessive heat.

The only exception to this standard is the microwave oven safety standard; it took effect in December 1971 and restricts accidental microwave leaks to five milliwatts per square centimeter. In the meantime, despite new evidence that further restrictions are needed, the 10-milliwatt standard has survived virtually unchallenged.

In recent years, however, the federal government has come under increasing pressure to make up for its years of negligence. Government agencies now spend approximately $9 million annually on research into the biological effects of microwaves.

Inquiries concerning recent microwave research are invariably met with words of caution; results are qualified with the "need for further research." Many researchers aren't even at the point where they can begin to actually collect and analyze data; many haven't yet secured the funding needed to proceed. Nevertheless, the Advisory Council that met in mid-February was able to discuss a number of interesting development.

- After studying 72 sites in four major cities, EPA researchers concluded that "less than 1 percent" of the general public is being exposed above those levels recommended as a general population exposure standard in the USSR (one microwatt per square centimeter). Translated into other terms, this means that "fewer than 83,000 persons" may be continually exposed to questionable microwave levels. Though average power densities were lower, four sites had radiation levels in the range of one to 2.5 microwatts per square centimeter, and one site was found to have levels of 2.5 microwatts. These measurements were taken at a height of six meters, and thus failed to take into account exposure in high-rise buildings (located nearer the top of a typical broadcast tower, where levels are higher). In addition, the experimenters did not attempt to measure exposure in occupational settings, where workers sometimes get "right on top" of microwave sources. Notes D.F. Janes of EPA's Office of Radiation Program, "In these situations, the level has frequently been found to be higher than the 10-milliwatt standard."

- In an as-yet unpublished study performed by EPA, "several tests" on rat pups that had been irradiated while in the womb and for 90 days following birth found that microwave exposure had weakened their white blood cells' "immune competence." (The lowering of white blood cells "competence" indicates a lessening of the body's ability to fight infection.) Levels of exposure were equivalent to "within a power of 10" of the 10-milliwatt standard for humans, according to one member of the research team. The frequencies used were those emitted by microwave ovens and by UHF broadcast transmissions.

- In a second study in EPA's laboratories in Triangle Park, N.C., veterinarian Ezra Berman reported preliminary findings that exposure to the same supposedly safe levels of microwave radiation may be responsible for a "low incidence" of a birth defect called encephalocle — a failure of the brain "case" to close over the brain at the time of birth. However, Berman added, pending a review of his data, he is not yet prepared to unequivocally state that exposure to microwaves causes birth defects.

- Studies carried out by the Defense Department indicated that rats will go out of their way to avoid low-level microwave exposure. One research team, using a "shuttle box" (a cage with two compartments joined by a corridor), found that when one compartment was exposed to five-milliwatt levels of microwaves, rats would move to the other. Others found "avoidance behavior" at levels as low one milliwatt. One scientist attending the Advisory Council meeting reported that in certain cases laboratory animals seemed to "go berserk," becoming "very aggressive and impossible to handle." (Council members warned that certain of these phenomena are not yet able to be termed "findings.")

- A final effect of microwaves may be the altering of the brain's chemical and biological balance. Because of the uniqueness of the brain's capillaries and chemical environment, a "blood brain barrier" blocks such unwanted large molecules as viruses, bacteria and certain proteins, while allowing glucose and oxygen to pass through freely. New research indicates that a cumulative effect of low-level microwave exposure may be a breaking down of the barrier's ability to exclude these large molecules. The result could be an increase in the incidence of brain swelling and infection.

- Concern over the effects of long-term low-level microwave exposure intensified after it was revealed that the U.S. Embassy in Moscow has been constantly subjected to such radiation since at least 1962. The presence of low-density radiation was discovered accidentally that year by security experts who were conducting an electronic sweep of the embassy to detect hidden listening devices.

American officials continue to puzzle over the reason for the radiation. The two most common theories suggest that either the Russians consciously set out to alter and disrupt the mental well-being and behavior patterns of embassy employees, or that the microwave beam was being used to foil the sensitive electronic devices inside the embassy used to eavesdrop on Russian communications.

In any event, the presence of lowpower microwaves was kept a secret from all but a select few until 1976 when a series of bizarre medical side-effects was found among embassy employees and their families, and reporters began to write about it. One of the most startling effects, reported only last January, was an abnormal increase in the number of white blood cells found among approximately one-third of all embassy employees. According to the White House Office of Telecommunications Policy (OTP), in its June 1976 annual report on the "assessment of biological hazards of nonionizing electromagnetic radiation," microwaves can "stimulate division of lymphocyte cells in the intact animal. . . . The possible indications of such effects are of interest because the lymphocytes, which are a type of white blood cells, are an integral part of the body's total immune defense mechanism." (This effect is separate from the lowering of the body's immune response, discussed above.) According to published reports, the level of exposure at the embassy was 18 to 20 microwatts per square centimeter, or approximately one five-hundredth of the "safe" U.S. standard.

Of course, one needn't go to the U.S. Embassy in Moscow to be exposed to levels of microwave radiation which the Rusians believe capable of damaging the body's nervous system. To date, the highest exposure to microwave radiation outside of occupational settings has been measured at Mount Wilson, Calif. In September 1975, an EPA team, working in cooperation with the Los Angeles County Department of Health Services, found ground-level microwave exposure levels ranging from one to 44 milliwatts per square centimeter. Mount Wilson is the home of antenna towers for 27 FM and TV stations serving the Los Angeles area. Within several hundred feet of the antenna is the Mount Wilson Post Office, which also serves as the residence of the postmaster. The maximum level of exposure in the vicinity of the building was found to be 4.8 milliwatts, though the level dropped off to six-tenths to six-hundredths of a milliwatt inside.

In occupational settings, the problem of microwave exposure becomes more acute. The existing voluntary exposure standard — currently 10 milliwatts per square centimeter, or a full 1000 times the maximum level allowed in the U.S.S.R. — has been adopted by the Occupational Safety and Health Administration (OSHA), theoretically because more definitive research findings are not available. Even so, due to problems in agreeing on measurement techniques and definitions, the 10-milliwatt standard is ignored by government and industry alike. According to studies conducted by the National Institute for Occupational Safety and Health (which serves as OSHA's research arm), microwave measurements in the textile, lumber and plastics industries revealed that "at least 80 percent of these radio frequency power sources create exposure levels in excess of current standards." Furthermore, in a substantial range of microwave frequencies, the OSHA microwave standard "is not practically useable."

It seems unlikely that the U.S. is about to drastically reduce its reliance on microwaves, or that the Pentagon will step forward with a voluntary plan to scale down its proliferation of telecomminications systems worldwide. But, it does appear obvious that we need significant restrictions on low-level, long-term exposure to microwaves, especially in the workplace. Government agencies with the power to do something about microwave standards include EPA, the Consumer Product Safety Commission, the Federal Communications Commission (FCC), the Department of Health, Education and Welfare's Bureau of Radiological Health, the Defense Department and the Occupational Safety and Health Administration. The question is how quickly and to what extent any of them will do anything.

Thus far Congress has been curiously silent on the issue of microwaves and the environment. With the exception of a set of hearings in 1973 sponsored by former Sen. John Tunney (D-Calif.), which explored — inconclusively — the dangers of microwave ovens, little has been done to educate the public or to review the research.

Rep. Henry Waxman (D-Calif.), a member of the House Communications subcommittee, recently contacted FCC Chairman Richard Wiley to request a review of the situation, saying, "the possibility of extensive biological damage from microwave radiation exposure is increasing in some proportion to the proliferation of microwave technology.

"This," Waxman wrote, "raises the most serious questions regarding the health and safety of the American people and the technological basis of the telecommunications industry." At press time, Wiley had not yet responded, although in an earlier statement the FCC concluded in typical bureaucratese that it has taken no action "because the health hazard from such radiation has not been defined, and because the equipment over which it has jurisdiction has tended to be constructed and operated in such a manner that significant practical radiation hazards have not been known to exist."

The Senate Commerce Committee also intends to assess the need for further congressional action. One problem, explains staff member Sharon Nelson, is that no one agency has exclusive jurisdiction over microwave safety standards. With six separate agencies all having thumbs in the pie, but no one of them taking the lead, it's hard to know where to direct responsibility. The reaction of each part of the bureaucracy so far, she said, has been to "take short runs, and then drop the ball."

Dilemma 5 — WHAT YOU DON'T SEE CAN HURT YOU

Hazel Lee's 33-year-old brother is a power line repairman who recently lost his sight as a result of cataracts. Hazel, a physician, is puzzled that her brother should develop cataracts at so young an age. Searching for an explanation, she found several studies linking certain types of cataracts with prolonged exposure to low levels of microwave radiation. She also found many studies linking microwave radiation to several other serious health problems.

Hazel became quite alarmed after reading these studies. She realized that people today are surrounded by microwave generating devices such as high voltage power lines, microwave ovens, TV sets, radar and television and telephone transmission towers. To make things worse, all of these devices are increasing in number.

Hazel feels that the danger levels set by the government are too high and that even small amounts of microwave radiation can be harmful. She feels that society must be alerted to these dangers.

Hazel presented her concerns to local citizens' groups and several state and federal agencies. Everyone ignored her. The people felt that if the current devices met government standards, they must be safe. Hazel believed, however, that the amount of microwave radiation people are exposed to must be reduced — especially in her town where there are several large television signal towers.

In her frustration over the lack of concern on the part of everyone, Hazel felt she had to do something dramatic. People, she believed, do not listen unless a very strong statement is made. She then developed a plan to cripple the local television relay tower.

Should Hazel carry out her plan? Why or why not?

SAMPLE OPINIONS

Bob "No. Hazel has no right to so blatantly damage property, especially a TV system that serves such an important function in the community. She will be defying the law as well as going against the needs of the community.

The government has established the standards. It has not been convinced by any new substantial evidence to the contrary. Can you imagine what might happen if people decide on their own what chemicals or types of radiation could be possible health hazards and attempt to sabotage the system? In our country it is important that people try to resolve problems in an orderly manner, following proper procedures and rules."

Gene "Yes. If a person has knowledge of a danger to society, he or she has a duty to alert society to those hazards as well as to try to put a halt to their increasing occurrence. Hazel has recognized the very serious nature of microwave radiation and is convinced that we can no longer ignore the problem. She would be committing a disservice to society if she remains silent. Change cannot take place by being inactive.

If use of microwaves continues to increase, it is possible that we may become so dependent on the producers of microwaves that we may reach a point of 'no return.' Putting a stop now can save the country from dire consequences in the future. In this case, I think the action is justified."

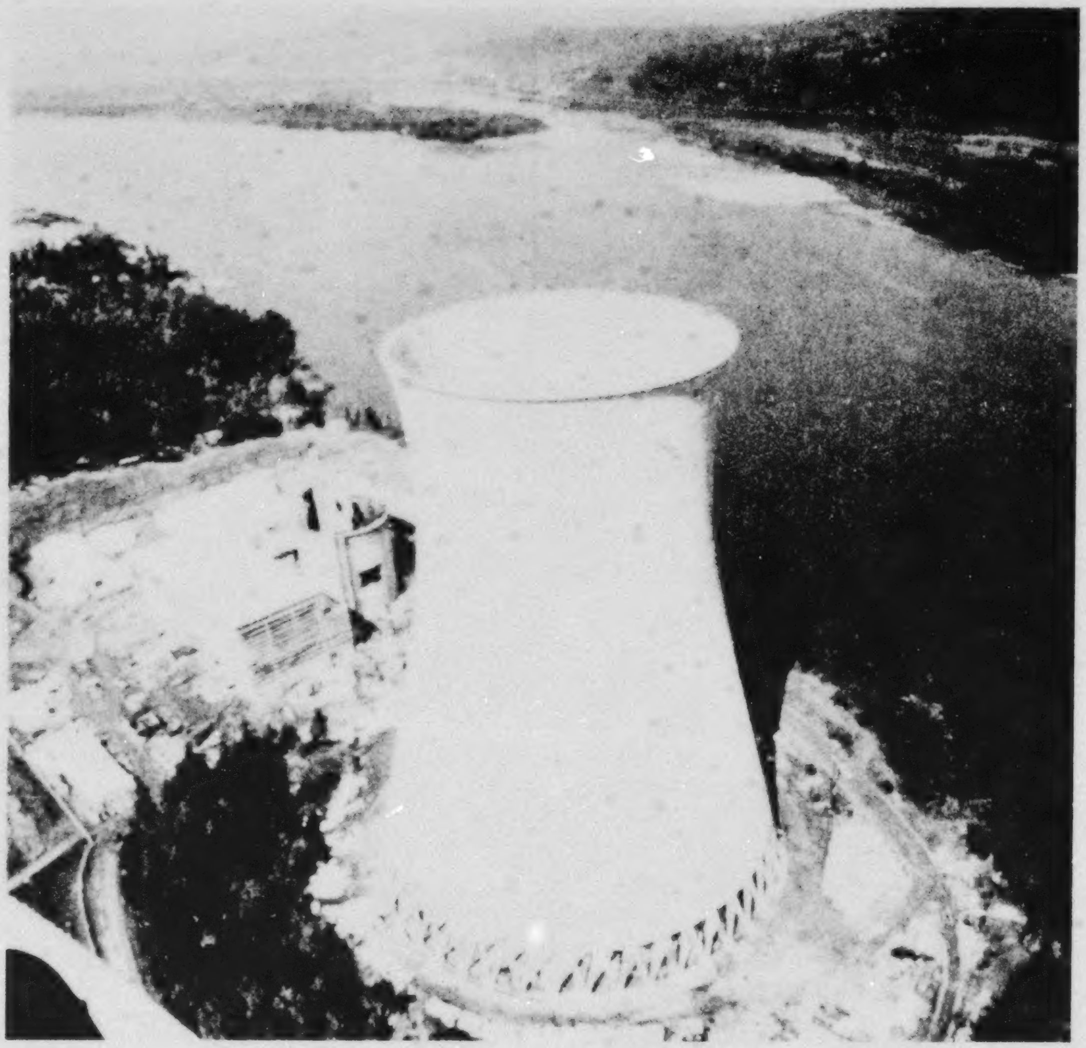
Tom "Yes, there is no doubt that she should. She has an important mission — she is trying to protect her community. Drastic action seems to be the only way that she can make her case heard. People do not take notice unless a strong stand is taken. Hazel knows how much her brother suffers from his blindness and doesn't want more people to endure such a fate.

If she doesn't do anything, who else would? Hazel, of course, is taking a great risk, but she's acting as would any good doctor who is concerned with the community's health and safety. The community should be grateful for her very brave act."

DISCUSSION QUESTIONS

- In view of the lack of public response to Hazel Lee's warnings about microwave hazards, shouldn't she simply have abandoned her campaign? Why or why not?
- If Hazel Lee carried out her plan to damage the microwave tower and brought about stricter microwave standards, would her drastic action have been justified? Why or why not?
- If microwave emissions do cause human illnesses, who should be held responsible? Television stations and the telephone company? The government? Why?
- Oftentimes scientists can't agree on the safety of a product. Should government "play it safe" and order it removed, or should it wait until conclusive evidence is obtained? Why? (Many low-level hazards are cumulative in that one has to be exposed for many years, even decades, before the effects become evident.)
- Whose responsibility is it to conduct and pay for research on product safety? Should the government support such research with public funds, or does industry have a responsibility to investigate and prove the safety of its products and operations? Why?

- What do you think is the most important factor for Hazel, as a citizen in a democratic society, to consider? Why is it important?
- Devices that emit microwaves are so common and important in our lives that reductions in their number and use would cause tremendous changes in our society. Should microwave standards be made more strict even though it will mean dismantling many TV and communication systems? Why or why not?
- Should workers who are exposed to high levels of microwave emissions be given higher wages to compensate them for the dangers to which they may be subjected to? Why or why not?
- How can people be alerted to dangers they don't want to recognize as existing?
- If people want to risk the possibility of future health dangers, should they be allowed to take the risk? Why or why not?



All The Power We Want, But . . .

Reading 1

The Great Nuclear Power Debate (1): A Summary

by John H. Douglas

The debate over nuclear energy is heating up again, with opposing positions more solidified than ever. A recent Harris poll shows 63 percent of Americans favor more nuclear power plants, but another poll shows 40 percent still have no firm opinions. During this year's elections, referenda on allowing construction of more nuclear reactors will appear on ballots of at least two states, and recent Congressional hearings have highlighted the issues involved. In this first article of a two part series, we present the contrasting, and often irreconcilable, positions of nuclear advocates and opponents. The second article will concentrate on the most controversial aspect of the debate, the breeder reactor.

Economics

Opponent

Utilities are beginning to realize that nuclear power isn't the blessing it was thought to be. Within the last two years they have canceled or delayed orders for the equivalent of 130 large nuclear plants. Construction costs range from 10 to 46 percent higher than conventional plants. Uranium prices have tripled over the last two years. Reactors would never have gotten this far (eight percent of the country's power-generating capacity) without huge Government subsidies; before they can develop further, more huge subsidies will be needed to build new enrichment plants to transform natural uranium into the fuel used by reactors. Once built, the reactors have not performed as reliabily as hoped, running at less than two-thirds capacity. The breeder reactor looks even worse: Development costs are projected to be $11 billion, but the actual cost of building a breeder demonstration project at Clinch River, Tenn., has escalated from $700 million in 1972 to $1.7 billion today.

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Advocate

Despite construction cutbacks caused by the recession, nuclear energy is still a bargain, generating electricity at 40 percent less than the cost of fossil-fuel plants, even after considering construction costs. In 1974, nuclear plants saved the country the equivalent of 163 million barrels of oil—some $2 billion worth. The price of uranium is such a small part of the total cost that it could quadruple again and nuclear energy would still be cheaper than conventional power. The initial Government subsidy of nuclear reactors has long since been surpassed by private investment, and the projected economic benefits of the breeder reactor are more than 12 times the cost. Of the cost increases at Clinch River, 60 percent were due to inflation and 20 percent were due to design changes. Nuclear plants are as reliable as conventional ones: From 1964 to 1973, conventional plants operated an average of eight and a half months a year; nuclear plants, around nine.

Danger from accidents

Opponent

The official Government study of reactor safety, the so-called Rasmussen report (SN: 8/31/74, p. 117 and 11/15/75, p. 310) has been severely criticized for underestimating human error (SN: 11/23/74, p. 330) and not adequately considering contamination of land areas by radioactive fallout following a major accident (SN: 5/3/75, p. 286). The study's methodology is questionable, assumptions such as adequate evacuation procedures are unrealistic, and the Environmental Protection Agency says the resulting casualty figures are too low by a factor of 10. Since the report came out, one of the "accidents that couldn't happen" did: A technician at the Browns Ferry, Ala., reactor complex set fire to the electrical control system, while using a candle to check for air leaks. The emergency core cooling system was knocked out, water in the reactor vessel dropped dangerously low, workers argued with firemen for five hours before following their advice on how to extinguish the fire, and no evacuation plans were set in motion.

Advocate

The key finding of the Rasmussen report was that an individual's chances of dying from nuclear accident are about the same as being hit by a meteorite— one in 5 billion. This methodology is imprecise but is the most sophisticated available, and a factor of 10 one way or the other is practically meaningless. For workers in all aspects of the nuclear business, the most danger arises in uranium mines, not around reactors, and new mining safety regulations are improving those conditions. The Brown Ferry incident demonstrates just how well the nuclear safety systems are designed to compensate for human error. Despite a fire directly under the control room, no evacuation was needed and no damage was sustained by the reactor, core or coolant piping. Despite loss of control over some of the cooling systems, alternative methods were available and successfully employed. There were no injuries and no release of radioactivity. Regulations governing worker conduct are constantly being updated to prevent such accidents.

Environmental effects

Opponent

In the normal operation of nuclear plants, some radioactive materials will inevitably escape and expose the public. Reactors also give off more waste heat than fossil-fueled plants of the same generating capacity, and this thermal discharge has already adversely affected the ecology of rivers and lakes. The biggest problem, though, is what to do with nuclear wastes; already 200,000 tons of discarded uranium left over in spent fuel has accumulated in 20,500 steel vessels at Oak Ridge and other sites. Some wastes remain dangerously radioactive for thousands of years—long after steel drums rust away. Not only is there a danger to the public of being exposed to the cancer-causing radioactivity of these wastes, but some of them, including plutonium, are so chemically toxic that accidental ingestion of even very small amounts can cause death. Even if one assumed that secure, long-range storage of these wastes could be found, the cost—including constant guarding for thousands of years—would be very large.

Advocate

The amount of radiation escaping from reactors is minuscule compared with naturally occurring radiation on earth; the average person receives one ten-thousandth as much radiation from the nuclear industry as from natural sources or medical X-rays. Thermal discharge could be used constructively—say, to heat homes, as in some other countries—if the public would accept it. Annual costs of all environmental effects associated with reactors are less than half those associated with coal-fired plants. Nuclear wastes are really not as much of a problem as some have claimed; Long-lived wastes are only half a percent of the total wastes, and these are now molded into insoluble solid masses. By 2010 the total volume of these solid wastes could fit comfortably into a single abandoned salt mine (a very stable geologic formation) at negligible costs. The spent uranium at Oak Ridge is being saved for use in the breeder reactor, where its value could be *trillions* of dollars. Plutonium is less toxic than many industrial chemicals in common use.

Terrorism

Opponent

Even if the problems of normal reactor operation, occasional accidents, waste transportation and storage could be overcome, no way has been found to calculate the impact of nuclear terrorism, or to adequately prevent it. A nuclear bomb can be made from only 10 to 20 pounds of plutonium, which is copiously produced in every reactor and shipped elsewhere for fuel reprocessing. On an NET television program, an undergraduate student demonstrated how easy it would be to steal some plutonium and design a bomb—which experts from the Swedish Defense Ministry said would explode. But the aim of the American nuclear industry is not just to build reactors here, where some safeguards do exist, but rather to export its technology, inevitably to countries whose obvious political instability will virtually assure nuclear weapons proliferation. To prevent nuclear theft and terrorism in the United

States will require establishment of what some have called a "garrison state," to prevent it abroad, nothing can be done.

Advocate

Relative to the nuclear power debate, the issues of terrorism and proliferation are simply red herrings—there are much easier ways to go about either. In the first place, the "10 to 20 pounds" of bomb material refers only to the weapons-grade, metallic plutonium-239, which never exists as such anywhere in the whole nuclear fuel cycle. It would take from 200 to 900 pounds of unprocessed nuclear fuel to make a very crude bomb, or 25 to 70 pounds of the reprocessed plutonium oxide—a much more difficult substance to handle than the weapons-grade metal. Designing a bomb may be simple (though none of the Swedish "experts" had actually ever built one), but preparing the materials requires an extensive industry, and assembling the device without cooking oneself is actually quite a trick. Conventional terrorism is a more immediate threat to civil liberties, and the best way to encourage responsibility among developing countries is through creation of a working partnership, based on such projects as nuclear power.

Alternatives

Opponent

Ultimately, the reason nuclear power development should be halted is that so many better alternatives are available, and needed development funds have been usurped by nuclear research. Some 40 percent of the energy consumption in the United States is unnecessary to begin with, according to some estimates. Savings of that amount could easily be obtained in buildings and cars, through careful redesign. The unemployment picture could be brightened if we let people take back some of the jobs machines took from them. For energy increases over the short-term, more coal could be used if the proper environmental protection devices were installed. Geothermal, solar and wind energies are waiting to be tapped in endless supply in various geographical areas, and these alternate sources have the added advantage of lending themselves to small, labor-intensive development. Finally, if one insists on nuclear energy, why not wait until the much safer fusion process is perfected, probably in the next century.

Advocate

Ultimately, the reason nuclear power must be developed is that no other viable alternatives are available, despite greatly increased funding. The wasteful elements of society cannot be changed overnight; the best estimate is that conservation can hold down total energy *growth* to two percent a year—still fast enough to double demand in 35 years. Even modifying 10 percent of the country's homes to solar heat would save at most 1.5 percent of our energy needs, but would cost at least $70 billion. Energy and jobs go together—just restricting oil imports to their 1973 levels would ensure a 10 percent unemployment rate over the next 15 years, if history is any guide. Power-generating plants using solar or wind energy are now extremely expensive, causing the power they would generate over their lifetime to cost two or three times as much as that from nuclear or coal. Opening new coal mines and power plants and installing pollution devices will take years and huge investment. Fusion is still chancy.

Reading 2

The Great Nuclear Power Debate (2): Breeder Reactors

by John H. Douglas

Americans still argue about the breeder's worth, but several other countries have quietly gone ahead with development — years ahead

Conclusion of a two-part series. SN's John H. Douglas recently interviewed nuclear scientists in the United States, Great Britain and France, and visited the online French breeder, Phénix.

When American scientists built the first small breeder reactor, in 1951—which generated the world's first electricity from nuclear energy—they placed it in the middle of an Idaho desert, a safe 50 miles from the nearest civilization. Similarly, the Russians have installed their large new breeder on a remote desert peninsula on the Caspian Sea, and the British have built both their breeders at the bleak northern tip of Scotland. But with that supremely Gallic dash of *élan* that says more about their confidence in their technology than any voluminous environmental impact statement, the French have constructed the 250 megawatt Phénix reactor (current leader in the breeder sweepstakes) 15 miles outside a major city, Avignon—in the midst of the famous wine vineyards of Côtes du Rhône.

Now, a quarter century after pioneering the concept, the United States is roughly 10 years behind other industrial countries in developing breeder reactors, even though the breeder program remains the largest item in the U.S. energy research budget (SN: 1/3/76, p. 5). By the time of the announced 1986 deadline for a decision on whether to build a commercial breeder in the United States (SN: 1/10/76, p. 21), Britain, the Soviet Union and a French-led continental consortium may each have commercial-sized prototypes on-line, with Japan not far behind. If these are successful, the countries involved will probably sell various portions of the nuclear power cycle around the world as fast as they can, and developing countries have already begun to line up to buy this new alternative to Middle Eastern oil (SN: 7/5/75, p. 6). The effect

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on U.S. trade could be severe, and the warnings of American environmentalists about global dangers of nuclear power would have come to naught (SN: 1/17/45, p. 44).

How this unaccustomed position of American technological inferiority came to pass revolves about some of the great conflicts of the past decade, including environmentalism, and distrust of science and technology. Where it is likely to lead involves equally momentous considerations: If the rest of the industrialized world succeds in entering a "breeder economy" in the 1990's, the United States must either have achieved extraordinary energy conservation and petroleum substitution or face a prolonged and socially devisive period of unemployment and recession.

The idea for a reactor that would "breed" more fuel than it burned goes back to the earliest days of nuclear power, to Enrico Fermi, who first proposed the concept in the early 1940's. Conventional reactors use a "moderator" (now usually plain water) to slow neutrons as they pass between rods of uranium fuel, making them easier to absorb and thus maintaining a nuclear chain reaction with a minimum amount of fissile material (usually the isotope uranium 235). But U-235 represents only 0.7 percent of naturally occurring uranium, too little to sustain a chain reaction, so the very expensive and energy-wasting "enrichment" process is necessary to raise the proportion of U-235 to 3.0 percent. In this process, huge amounts of the majority isotope, U-238, are set aside, and after the spent fuel is removed from a reactor, even more U-238 is left over.

The purpose of the breeder is to convert this surplus U-238 to a more useful form. If an atom of this isotope absorbs a neutron, it changes to plutonium 239, which can then be used as a reactor fuel. This conversion goes on to a certain extent in all reactors, but it proceeds much faster with unmoderated neutrons. To have a reactor that can produce, say, in 10 years, twice the amount of fuel it consumes, a larger number of fuel rods is needed than in conventional reactors. (Unmoderated, or "fast," neutrons are harder to absorb.) These rods are surrounded by rods of U-238 to be "bred." Since water can no longer be used, heat to drive external electrical generating plants must now be taken from the reactor by circulating a liquid that does not moderate neutrons—usually liquid sodium. Thus, a large and expensive Liquid Metal Fast Breeder Reactor (LMFBR).

The advantages of the LMFBR over the conventional, "light" water reactor (LWR) are considerable—if one assumes all goes well. Aside from breeding, a faster reactor makes more efficient use of fuel. More important, according to the Energy Research and Development Administration (ERDA), even with lower energy demand, uranium will be in short enough supply by 2010 that the cost of nuclear power generation will be around 15 mills per kilowatt-hour, and rising sharply. If breeders are introduced by 1987, however, the cost would be only 12.5 mills and failing sharply. Domestic oil and gas are expected to be pretty well depleted by then, solar and fusion energy would probably still make relatively small contributions, and the cost of coal-generated electricity will be almost 20 mills per kilowatt-hour. [Constant 1974 dollars.]

The disadvantages of LMFBR's hinge mainly on a pessimism about technology or an optimism about society. Theoretically, at least, a breeder could explode (ERDA prefers the term "dissassembly process" induced by "autocatalytic recriticality" and emphasizes the chances are *very* small). The amount of dangerous material present is impressive: Each 1,000-megawatt breeder would contain some 50 metric tons of uranium and plutonium and 40,000 cubic feet of radioactive sodium coolant at temperatures up to 1,100 degrees F.—hot enough to catch fire if exposed to air. Fuel would have to be transported to reprocessing and fabrication plants, each of which would handle some five metric tons of combined uranium and plutonium a day. Intense argument continues as to whether the various installations of the nuclear fuel cycle should be clustered together in "nuclear parks," where a freak accident or sabotage might destroy them all, or whether the risk is greater in transporting large amounts of radioactive material about the countryside.

Not to build the breeder, however, also involves some risks, for one essentially has to assume that either a miracle will happen—such as invention of cheap, efficient photovoltaic cells—or that society will accept the changes of life style implicit in stringent energy conservation and neighborhoods built around small solar heating plants. The biggest crunch would come in unemployment. According to nuclear advocate Rep. Mike McCormack (D-Wash.), the energy equivalent of 48 million barrels of oil a day is the smallest amount that can keep American homes heated, cars running and industries going in 1985. For each million-barrels equivalent that supply falls below that, he estimates that some 900,000 people will lose their jobs. Society could, of course, be restructured (smaller cars and better insulated homes seem certain to come); but even assuming an aggressive conservation program, McCormack says, the nuclear portion of the 1985 consumption figure will equal 6 million jobs, "and there is no substitute for it." Such arguments go far with Congress. They probably explain why McCormack could recently tell *Science News*, "In every test case we've had in Congress, the vote has been overwhelmingly in favor of nuclear energy and the breeder."

Then why has the United States breeder program apparently fallen so far behind? "We've become demoralized and cynical," one leading scientist in the program told *Science News*. "We've been raked over the coals." Even before the present antinuclear outcry reached its thunderous proportions, however, the direction set for the American breeder program by its head, Milton Shaw, was being sharply criticized on technical grounds. His own subordinates accused him of overmanaging the development effort, questioned his technical and economic decisions, and opposed his single-handed elimination of alternative designs. The result was an almost academic approach to an essentially mission-oriented problem—a continual series of experiments designed to establish basic knowledge, rather than a progressive set of prototypes aimed from the start at developing a working reactor. Finally, the exceptionally low oil prices of the late 1960's lulled

American budget planners into believing there was no particular rush.

Not so, the Europeans. In France, Charles de Gaulle decreed the same sort of all-out commitment to develop a breeder that John F. Kennedy had commanded for America's race to the moon. In both cases, the secret of success was the experienced teams of scientists and engineers assembled to work together for a decade toward a single goal. (In the American breeder program the technical teams have changed several times.) When a commercial breeder reactor is finally marketed in Europe, perhaps half a dozen countries will be involved in its creation, but as the Phénix chief operating engineer Bernard Giraud, confidently told *Science News*, "The continuity will be French."

Some setbacks have, of course, occurred, as one would expect in a program at least as costly and complex as the space race. The British Prototype Fast Reactor (PFR) at Dounreay, Scotland, should have been completed before Phénix, but industrial problems hindered delivery of some components, and shortly after beginning operations some 500 tons of seaweed got sucked into the condenser of the power-generating system. PFR should reach full power this spring.

A more fundamental design problem, faced by several nations, was described for *Science News* by Thomas N. Marsham, deputy director of reactor development for the United Kingdom Atomic Energy Authority (UKAEA). When a single weld is used to separate water and sodium, tiny leaks can occur ("really more of a porosity than a leak," says Marsham). Reaction between the two chemicals produces hydrogen, which can build up in the heat transfer tubes. In the PFR enough redundancy of parts had been included to simply allow leaky tubes to be plugged, but the new rule of design is never to have just one weld separate sodium and water. French designers reached a similar conclusion, but they place more emphasis on eliminating thermal stresses that result when dissimilar metals or different thicknesses are welded together. (Welding problems are also plaguing undersea oil pipeline designers.)

One possibly decisive factor in allowing other countries to pursue an accelerated breeder program is public acquiescence. Outside the United States, environmental decisions are usually handled like other technical matters — by experts. In Britain, public comment is invited, but the final decision is left up to the Government, without recourse to lengthy court battles that have slowed or halted several nuclear projects in this country. French public opinion has not yet been aroused one way or the other, and if pressure for alternative policies should occur, it would probably be hopelessly enmeshed in party politics. The Russians have reportedly adopted very large safety margins into their reactors through strictly internal technical debate. Their philosophy is to emphasize high quality at critical points (while leaving outside buildings to be crudely built by convict labor), rather than worrying about maximum hypothetical accidents, as American scientists have to do.

Though such attitudes may at first seem cavalier to environmentally conscious Americans, one cannot help being impressed with both the technical achievement and care for safety evidenced by a walk through Phénix. Passing through the double doors of an air lock that allows the entire building to be sealed in case of an accident, one can move freely about the cavernous room surrounding the top of the reactor, receiving less radiation than if the reactor were a conventional, water-cooled type. The uncluttered hardware shows the touch of a well-planned, efficient operation. In the control room, a computer continuously monitors every aspect of the reactor and power generating operation. Some safety procedures are automatic — the computer will shut down the reactor in the event of unexpected temperature rise or power failure — but other variables are put under the operator's direct control, including reactor power, which is controlled by remote manual adjustment of sodium flow.

In its first year of operation, Phénix achieved a noteworthy 84 percent availability. The "doubling time" for breeding new fuel is stll far too low, but all designers emphasize the experimental nature of this generation of reactors and expect to concentrate on the breeding and economic aspects in future models.

Many uncertainties remain to be settled before the coming of the Breeder Age, including technical and economic problems of the reactor itself and the relative merits of various countries' approaches. The United States still depends less on imported petroleum than Europe (with the possible exception of Britain, after enough North Sea oil comes on stream), and this might be able to justify some delay. Uranium resources are very uncertain, and some estimates indicate that as long as enough domestic high-grade ore deposits are found, the cost differential between building light water reactors and the more expensive LMFBR's could not be justified.

Most experts think such a bonanza is unlikely, but the inordinate escalation of reactor construction costs worries everyone. One provocative study conducted at MIT's Center for Policy Alternatives (summarized in *Technology Review*, February 1975) concludes that, unlike the ERDA predictions, capital costs for conventional nuclear plants are rising so fast that coal will be competitive by 1980. At the very least, this conclusion challenges the timing of breeder introduction. (ERDA experts "violently disagree" with these figures.) But perhaps the most interesting conclusion of the analysis is that a principal factor causing nuclear construction costs to rise more rapidly than those of fossil fuel plants is the very process of antinuclear intervention. The authors conclude that the unique regulatory process that governs nuclear energy "has been used as a device to give effect to the view that reactor technology is not as valuable to society as the anticipated cost of electricity from the first-generation plants implied." In other words, nuclear energy's biggest problem is political.

Relative to foreign competition, the fact that the United States will not have an equivalent to Phénix until nearly a decade after the French may be a little misleading. Westinghouse scientists conclude that the French design "could not meet current U.S. safety standards and licensing requirements," and hence it is not yet able to compete in the lucrative American power generation market. (Others disagree.) Furthermore, by taking a somewhat pedestrian approach, American scientists may be able to avoid some spectacular blunders, such as a large hydrogen leak (some say explosion) at Shevchenko and 500 tons of Scottish seaweed. Meltdown of an LMFBR at Newport, Mich., in 1966 does not help this thesis, however.

The key factors to breeder development are commitment and cooperation. Some American experts fear that if the Europeans can manage a truly joint development project — combining the best features of the British and French designs — to market a commercial breeder reactor on their proposed time scale, the United States could suffer a severe economic setback, equivalent to the Arab oil embargo. Likewise, European scientists express apprehension that the American Government could suddenly ease licensing requirements and "let your private companies just get on with it," implying that the U.S. industrial infrastructure is still powerful enough to quickly close the existing gap if circumstances permitted.

Though all the British and French scientists and politicians who spoke with *Science News* expressed optimism over more cooperation across the Channel, none would speculate on when or how it might come about. But little doubt exists about the all-out commitment to the breeder; says UKAEA's Marsham, "I can never remember a time there was so much unanimity in the United Kingdom over energy supply." Certainly no American scientist can say *that*.

Dilemma 6 — ALL THE POWER WE WANT, BUT . . .

Like many countries of the world, Spartania is experiencing difficulties in trying to meet the electricity and heating needs of its people. As the availability of oil and natural gas declines, the prices for these fuels have reached "astronomical" levels. Spartania is faced with a dilemma. It can continue to pay the increasing prices for oil and natural gas and as a result deprive its people of other essential needs, *or* it can expand its present nuclear capability—which, in the long run, may be far cheaper than fossil fuels.

The Minister of Energy is particularly interested in the breeder reactor. The breeder reactor is so called because after being initially fueled with plutonium and uranium it will both generate electricity *and* produce or "breed" more plutonium from the reaction. The breeder is particularly appealing to the Minister because it has been reported that this reactor is capable of expanding the energy yield of uranium by 50 times. That is, much of the waste will become usable fuel. This, he feels, is extremely economical since his country has to import all of its uranium. In addition, the Minister feels that some of the waste products of the nuclear reaction might even become useful in the future should Spartania decide to develop nuclear weapons. Simply, the breeder reactor can provide for all of Spartania's energy needs in the foreseeable future at very low cost.

On the other hand, if the Minister of Energy decides to build the breeder reactor the country will be confronted with new and difficult problems. Such problems include the increased possibilities of nuclear accidents, the hazards of transporting nuclear fuels and wastes to and from the reactor, and, most importantly, the disposing of nuclear wastes.

Radioactive waste materials remain dangerous for hundreds of thousands of years. In some countries nuclear waste materials are placed in special containers and buried in deep salt deposits. In Spartania, however, there are no salt deposits and burying the wastes could contaminate the ground water—the main source of drinking water for the people of Spartania.

Should the Minister of Energy decide to build fast breeder reactors? Why or why not?

SAMPLE OPINIONS

Sandra "The Minister of Energy has a duty to insure that his country continues to have sufficient energy supplies. Although he must weigh the advantages and disadvantages of fast breeder technology, the most important fact is that fossil fuels will eventually be depleted and uranium must be used more efficiently.

Moreover, he knows that low cost energy is important and he must reduce the country's dependence on imported oil. The country must also have its store of nuclear weapons for its national defense.

The reported studies show that risk of nuclear accidents is very low and new, improved technologies will further insure the safety of reactors."

Joanne "This is a very critical decision and the Minister of Energy must consider the fact that it will affect future generations. How can he commit future citizens to a decision that might endanger their health and lives? Everyone has the right to a quality life, and this quality is related to good health. Radiation exposure can produce irreversible, undesirable genetic diseases. This is too high a risk to take for the benefits people gain today. Plutonium remains radioactive for thousands of years.

One's decision must take into account total possible effects on human welfare. One can't affort to be shortsighted."

John "I don't think the Minister of Energy has any other choice but to build a breeder reactor. It is the most practical solution for meeting the country's energy needs. The country can't continue to depend on importing fuel forever. The development of the country and higher standards of living depend on abundant, low-cost energy.

The Minister of Energy wants to help his country meet its energy needs. He should take advantage of the latest scientific advances. If other countries will be using fast breeder reactors, why shouldn't Spartania? To not use such a source of energy will plunge the country back to the Dark Ages. The Minister can't let his country fall behind and be blamed for denying its people higher levels of living comforts. Money saved from importing expensive oil can be spent on schools, hospitals and other services."

DISCUSSION QUESTIONS

- What should be the Minister of Energy's most important consideration in making his decision? Why?
- Should the Minister of Energy have any obligations to future generations of Spartanians? Which decision would have the gravest consequences—to leave future Spartanians with insufficient energy or to leave them with a stockpile of radioactive waste? Why?
- From the standpoint of the Spartanian society, which decision is the best one? Why?
- If Spartania does not have low cost energy sources, many of its factories may have to shut down, leaving its people even more dependent on foreign exports. Should the people be willing to accept some risk associated with breeder reactors? Why or why not?
- Should the Minister of Energy make this decision on his own or should he involve others in the decision-making process? If you feel other individuals should be involved who would you include in the group?
- Do people have the right to engage in activities that could drastically affect the health of those who will be living several hundred years later? Why or why not?
- If the majority of the people in Spartania wanted the breeder reactor because it would mean improving their standard of living, should the Minister of Energy go along with their wishes, despite his concerns over future effects?
- Since many other countries are planning to build breeder reactors, why shouldn't Spartania also develop its own so that the country can benefit from a low cost fuel source?

Coal From Mother Earth

Reading 1

Getting More Energy[1]

As the nation's oilmen see it, the biggest flaw in Jimmy Carter's energy policy is that it does little to spur production of more oil and natural gas. But the emphasis was intentional. Convinced that the U.S. is rapidly losing its oil and gas reserves, Carter's men have decided to begin weaning the economy from its petroleum habit and forcing it to rely more on its rich reserves of coal. At the same time, the President aims to launch a long-range effort to develop power from the atom, the sun, the wind and the sea.

Forcing A Switch

America is the Saudi Arabia of coal, with enough in the ground to supply all of its energy needs for centuries. Carter wants to increase coal production to 1 billion tons a year by 1985, about 65 per cent above current output. The plan is to tax utilites and other industries that use oil and gas as boiler fuel, forcing them to switch to coal. The tax on large industrial users would begin in 1979; for utilities, which would require more time to convert, it would be delayed until 1983. Such a massive shift to coal seemed to promise a boom for coal producers and the railroads that would haul coal. But the costs of using coal are rising on every front—and both the digging and the burning of it clash with Carter's own environmental policies.

The President insisted that he could meet his goals for production while adhering to strict standards on clean air and strip-mining. Carter supports, for instance, the bill passed by the House Interior Committee last week that would force producers to return coal-stripped lands to their original contours and restrict surface mining on prime farm lands and in national forests. "It's the story we've come to expect from Washington," complained president Otis Gibson

[1] This selection is excerpted from "Getting More Energy," *Newsweek*, May 2, 1977, pp. 27, 28. Copyright 1977 by Newsweek, Inc. All rights reserved. Reprinted by permission.

of the Illinois Coal Operators Association. "We're going to increase production, but we're going to increase restrictions on the mining and burning of coal. That's not a very consistent program."

While the coal industry will probably be able to live with the strip-mining bill, the clean-air requirements pose far harder questions. The President wants to expand research to find ways to make coal burn more cleanly, and he wants "scrubbers," which remove much of the sulfur dioxide from stack emissions, installed on all new coal-fired electric power plants. But scrubbers are expensive and industrialists argue that their technology is undependable. Joel Price, a Wall Street coal analyst, says scrubbers increase costs by $12 to $15 for each ton of coal burned.

The utilities will find conversion to coal a problem, too. The Edison Electric Institute estimates that the cost of switching gas- and oil-fired power plants to coal between now and 1985 will be fully $50 billion—a particularly annoying expense to those utilities that in recent years had switched from coal to gas or oil as being cleaner and cheaper. Commonwealth Edison Co., for instance, spent $10 million five years ago to convert one of its Chicago stations from coal to gas. If it were to reconvert to coal now, the company says, the cost would be $110 million.

Reading 2

Touch The Earth[1]

The great care with which so many of the Indians utilized every portion of the carcass of a hunted animal," writes anthropologist Dorothy Lee, "was an expression, not of economic thrift, but of courtesy and respect; in fact, an aspect of the religious relationship to the slain." The Wintu Indians of California lived on very densely wooded land where it was difficult even to find clear [illegible] to erect houses. "Nevertheless," continues Lee, "they would use only dead wood for fuel, out of respect for nature." In the following passage, an old holy Wintu woman speaks sadly about the needless destruction of the land in which she lived – a place where gold mining and particularly hydraulic mining had torn up the earth.

The White People Never Cared for Land or Deer or Bear.

When we Indians kill meat, we eat it all up. When we dig roots we make little holes. When we built houses, we make little holes. When we burn grass for grasshoppers, we don't ruin things. We shake down acorns and pinenuts. We don't chop down the trees. We only use dead wood. But the White people plow up the ground, pull down the trees, kill everything. The tree says, "Don't. I am sore. Don't hurt me." But they chop it down and cut it up. The spirit of the land hates them. They blast out trees and stir it up to its depths. They saw up the trees. That hurts them. The Indians never hurt anything, but the White people destroy all. They blast rocks and scatter them on the ground. The rock says, "Don't. You are hurting me." But the White people pay no attention. When the Indians use rocks, they take little round ones for their cooking. . . . How can the spirit of the earth like the White man? . . . Everywhere the White man has touched it, it is sore.

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[1] This selection is excerpted from *Touch the Earth: A Self-Portrait of Indian Existence*, compiled by T. C. McLuhan. Copyright © 1971 by T. C. McLuhan. Reprinted by permission of the publisher, E. P. Dutton.

Last year the Peabody Coal Company, a subsidiary of Kennecott Copper Company, began stripping coal from 65,000 acres it has leased from the Navajo and Hopi tribes. Company officials declared that this mining would not damage Indian lands and in fact would improve the lives of many Navajos and Hopis. In disagreement with this action a group of Hopi wrote the following letter to President Nixon:

Dear Mr. President:

We, the true and traditional religious leaders, recognized as such by the Hopi People, maintain full authority over all land and life contained within the Western Hemisphere. We are granted our stewardship by virtue of our instruction as to the meaning of Nature, Peace, and Harmony as spoken to our People by Him, known to us as Massau'u, the Great Spirit, who long ago provided for us the sacred stone tablets which we preserve to this day. For many generations before the coming of the white man, for many generations before the coming of the Navajo, the Hopi People have lived in the sacred place known to you as the Southwest and known to us to be the spiritual center of our continent. Those of us of the Hopi Nation who have followed the path of the Great Spirit without compromise have a message which we are committed, through our prophecy, to convey to you.

The white man, through his insensitivity to the way of Nature, has desecrated the face of Mother Earth. The white man's advanced technological capacity has occurred as a result of his lack of regard for the spiritual path and for the way of all living things. The white man's desire for material possessions and power has blinded him to the pain he has caused Mother Earth by his quest for what he calls natural resources. And the path of the Great Spirit has become difficult to see by almost all men, even by many Indians who have chosen instead to follow the path of the white man. . . .

Today the sacred lands where the Hopi live are being desecrated by men who seek coal and water from our soil that they may create more power for the white man's cities. This must not be allowed to continue for it it does, Mother Nature will react in such a way that almost all men will suffer the end of life as they now know it. The Great Spirit said not to allow this to happen even as it was prophecied to our ancestors. The Great Spirit said not to take from the Earth — not to destroy living things. The Great Spirit, Massau'u, said that man was to live in Harmony and maintain a good clean land for all children to come. All Hopi People and other Indian Brothers are standing on this religious principle and the Traditional Spiritual Unity Movement today is endeavoring to reawaken the spiritual nature in Indian people throughout this land. Your government has almost destroyed our basic religion which actually is a way of life for all our people in this land of the Great Spirit. We feel that to survive the coming Purification Day, we must return to the basic religious principles and to meet together on this basis as leaders of our people.

Today almost all the prophecies have come to pass. Great roads like rivers pass across the landscape; man talks to man through the cobwebs of telephone lines; man travels along the roads in the sky in his airplanes; two great wars have been waged by those bearing the swastika or the rising sun; man is tampering with the Moon and the stars. Most men have strayed from the path shown us by the Great Spirit. For Massau'u alone is great enough to portray the way back to Him.

It is said by the Great Spirit that if a gourd of ashes is dropped upon the Earth, that many men will die and that the end of this way of life is near at hand. We interpret this as the dropping of atomic bombs on Hiroshima and Nagasaki. We do not want to see this happen to any place or any nation again, but instead we should turn all this energy for peaceful uses, not for war.

We, the religious leaders and rightful spokesmen for the Hopi Independent Nation, have been instructed by the Great Spirit to express the invitation to the President of the United States and all spiritual leaders everywhere to meet with us and discuss the welfare of mankind so that Peace, Unity, and Brotherhood will become part of all men everywhere.

Sincerely,
(signed) Thomas Banyacya, for
Hopi Traditional Village Leaders:
Mrs. Mina Lansa, Oraibi
Claude Kawangyawma, Shungopavy
Starlie Lomayaktewa, Mushongnovi
Dan Katchongva, Hotevilla

Reading 3

An Empty Black Pit

"I am a Cheyenne. I have traded my tribal lands to the coal company for a pocketful of greenbacks.

"I have sold the land of my tribal heroes. Now the money is gone, and I am alone.

"The history books will say: 'Once there was a reservation. Once there was people called the Northern Cheyenne.

"Now there is nothing. Nothing but an empty black pit."

(This statement was nailed to the wall of the Jimtown Bar, just across the reservation line.)

Lame Deer, Montana — The Northern Cheyenne here wonder if the energy crisis of the Euro/American people will spell out their doom. Under the tan sandstone buttes and the rolling, grassy river bottoms of their 415,000-acre reservation here — an isolated area 100-miles east of Billings which they struggled for until it was finally awarded to them in 1884 — lies a large deposit of coal.

Large Eastern fuel conglomerates are bidding for it as if it were gold. Until recently, Western coal was regarded as too distant from consumers to be of importance. But because the fuel here is low in sulphur and can be burned to generate electricity without violating Federal air pollution limits on sulphur dioxide emissions, the enormous reserve in the Fort Union Basin of Montana, Wyoming, and the Dakotas has suddenly become much more of importance.

Some experts believe that the area — one of the few places in the U.S. where you can still get some sense of how it was before the white man came — will become the largest industrial development in the world.

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That is the forecast of the 20 electric utilities — including the Interior Department's own Bureau of Reclamation — in a report which is available from the Bureau, entitled *North Central Power Study – Phase I, Volume I*.

James E. Parker of the Bureau's power division in Washington says that the power development alone might be one of the largest in the world. It would, alone, produce one-seventh of the electricity now used in the United States.

Water would be carried from a complex system of aqueducts from the Bighorn, Yellowstone, Tongue, and Powder Rivers to cool the plants. More than $^4/_5$ of the Yellowstone's water would be needed.

The utility executives view the semi-arid prairie and badlands where the plants would be built as virtual wasteland, good only for the grazing of a few cattle. "My God, they want us to worry about the lichen," said the executive of one firm, exasperated with what he called the "nit-picking" of an environmental group.

Ecologists view it differently. To them, it is a delicate eco-system, subject to damage from even minor stresses let alone something like strip-mining. And then the Cheyenne and Crow have their own religious/ecological perspective.

Certainly the view of some native people will be that the development will bring jobs, and tribal councils will see royalties coming in to their treasury. But primarily, the people who will get rich from the project will be those who finance it, those who build it, those who utilize the power in far-away places — they lack only one thing to make it possible, and that's the fuel, much of which is under Indian land.

The Northern Cheyenne people own the biggest chunk of the reserve — perhaps two billion tons. Tom Gardner, a 37-year-old Cheyenne who is the reservation's antipoverty and community action director, says that the Cheyenne are facing a "question of the white man's extinction of our way of life. We see prosperity from the coal," he says. "But we also see many thousands of white people — perhaps 30,000 miners and technicians and the people serving them, when we are only a few thousand. We see a population explosion, with bars, beer taverns, and discrimination against our people. My people are not competitive in the white man's sense and will be left out, swept aside. So it is not only coal we would lose and the damage to our lands for a few million dollars. It is our life."

About 6 months ago, a report from the government's auditors, the General Accounting Office reported on the stripping of Indian lands elsewhere — trees, grasses, and topsoils had been removed under less-than-ideal supervision. Leases that were negotiated by the Interior Department to "help" the Indians had been, instead, overly favorable to the mining industry. It said that the leases didn't even follow the department's own environmental and reclamation requirements.

Interior replied to the criticism by saying it did not have enough money to properly police the matter, but congressional critics observed that the department hadn't asked for any new money to upgrade its efforts in this area.

When President Richard Nixon gave his recent environmental message to the U.S. Congress, he offered pro-industry proposals which last year were rejected by the House in favor of a stronger bill. This would indicate that if the native peoples are to have strict enforcement or prohibition of strip-mining, they will have to do it themselves.

Even white people in the area are starting to understand what it might mean to be an Indian. Most of them do not own mineral rights to their lands, and are almost helpless to prevent the large companies from strip-mining. As they move out to aid "progress", they must think of how their own forebears not so very long ago usurped the land from the Indians — for the same reason.

If Consolidation — which is owned by Continental Oil Company — wins the leaserights, they will have the right to assign their rights to other firms, to sublease railroad or roadway rights, and control the whole thing.

Another Continental company, Hanna Coal, operates strip mines in the east. One machine, the Giant Earth Mover, is as big as an office building. It is 200 feet high, weighs more than 7,000 tons. It operates 24-hours a day 7 days a week, and uses enough electricity to supply a city of 15,000. It is operated by one man, who rides in an elevator up to his cab. Each chomp take out 220-cubic yards of earth.

Strip mining has to be seen to be believed. The monster machines cut deep, long trenches one beside the other to reach the coal. The pulverized rock and earth taken from the trenches is dumped nearby in large mounds. This results in the complete destruction of the land — landslides, erosion and siltation are major results. Erosion entering streams and rivers destroys them as life-supporting waters. Acid and mineral pollution also result as the coal shale is brought to the surface.

While the companies point to certain areas that have been somewhat reclaimed, to date of the 1.8 million acres of land damaged by stripping, only 56,000 acres have been reclaimed in any way.

Efforts to halt strip-mining across the United States have been underway for years, and legislation to halt the operators was stalled in the last Congress. In Kentucky, mountain women have united to lay down in front of bulldozers — some went to jail for interfering with operations on their own land.

Whether Cheyenne people will be called upon to do the same depends on what happens next in Lame Deer.

Even the U.S. Senate was not immune to executive arrogance. Secretary of Interior Morton refused to uphold a resolution passed by the Senate October 12, 1972, calling for a moratorium on further coal leasing of federal lands in Montana for one year, or until the Senate could act on strip-mining legislation. (Members of Morton's family are coal-mine corporation executives with interests in Montana.)

Indian lands in Montana contain approximately one-third of the state's total 30-billion tons of strippable coal reserves. Some of it is owned by the Fort Peck Reservation in northeastern Montana, but the largest and most valuable deposts underlie the entire Crow and Northern Cheyenne reservations in the southeastern part of the state, roughly in the heart of the prized Colstrip-Gillette area.

Beginning in 1966, the BIA — the legal protector of Indian resources which must approve all tribal permits and leases — brought coal companies to the Northern Cheyenne Tribal Council, encouraging that body ultimately to sign a total of eleven exploratory permits for the tribe's land. Uninformed of the omissions and deficiencies of the BIA coal leases, the tribal council put its trust in its trustees, the BIA, one of whose officials, urged immediate action by saying as late as 1972, "There are indications coal will be a salable product for only a few years."

Encouraged to take money while the taking was still good (bonuses, rentals with a floor of one dollar per acre, and royalties of 17.5 cents a ton) the tribe let out to Peabody, Amax, Consol, Norsworthy & Reger, and Bruce Ennis a total of 243,808 acres — a startling 56% of the reservation's entire acreage!

The permits were loosely worded as to reclamation and other environmental considerations, and gave the operators the right to exercise lease options which were appended as part of the original agreements and which set forth the monetary and other terms of the leases: Thus, a permit holder could explore for the coal, discover its value, then secure it without the seller being able to negotiate for the really true value of the coal. The leases, in turn, gave the purchaser the right to use the Indian land for all manner of buildings and installations necessary for the production, processing, and transportation of the coal, opening the way for the construction of power, conversion, and petrochemical plants, railroad lines, associated industrial complexes, and new towns of non-Indians, whose numbers would submerge the approximately 2500 Northern Cheyennes and turn the reservation quickly into an industrialized white man's domain.

Most members of the tribe were uninformed about the terms of the leases, but when Peabody and Amax exploration crews appeared, drilling among the Indian burial grounds and disrupting Indian lives, friction and unrest developed rapidly. Fearful for the future of the reservation, their culture, and the tribe itself, a number of Cheyenne, mostly those who held allotments of their own land on the reservation, formed the Northern Cheyenne Landowners' Association to oppose the coal development.

At almost the same time, Consol entered negotiations with the tribal council for another 70,000 acres of the tribe's land, which would have brought the total acreage held by permittees to 72% of the reservation. Consol's proposal, which was not made public to the tribal members, offered $35 an acre and and a royalty of 25 cents a ton — 7.5 cents above what the federal government was getting for BLM coal, and what the Cheyennes had received in all previous leases.

To the startled tribal council, Consol explained that it intended to invest approximately $1.2 billion in an industrial complex that would include four coal gasification units, and that implied a city of perhaps 30,000 non-Indian people inundating the small Indian community. The company was in a rush to get the permit signed. It urged the Cheyennes to forgo the usual practice of asking for competitive bids ("it would mean the loss of several months income") and it offered the tribe $1.5 million toward the cost of a new medical center — needed badly by the Indians, but also by the non-Indian industry, whose employees would, according to a clause in the proposed agreement, have access to the facility — inevitably to become the center's major users.

The company had pressed hard to present an acceptable offer to the Cheyenne council. Giving the tribal council just 15 days to accept or reject it, a July 7 letter from Dell Adams, the company's western vice-president, said that if the offer were not accepted "at an early date. Consol would be forced to take the project elsewhere. If it is necessary to do this," the letter warned, "this project will be lost to the Northern Cheyenne, and it may be a long time before a project of this magnitude comes again, if ever."

But the company which had prospective customers of its own for the coal, needed the deal more than the Cheyennes did. Word of the proposal leaked out to the Northern Cheyenne Landowners' Association, and public meetings were held, cautioning the tribal council to go slowly. The higher price offered by Consol also started new thinking. But when Peabody exercised its options to lease at the old low price, it raised the question of whether the initial transactions were fair.

Peabody's activities also were causing many resentments among the Cheyenne — the terms of the lease were now seen to be too loose for the protection of the reservation; the enforcement of strip-mining procedures in the code of federal regulations was not being observed by the BIA, and the possibility that corporations would erect gasification plants and other installations on Peabody's leased land posed a fearful threat to the Cheyennes future.

The same questions were raised about Amax's permit, while in connection with a third permit, given to Bruce Ennis, the Billings lawyer, and then assigned by him to Chevron, the Cheyennes wondered if there had been speculation with their property, and if Ennis had received a royalty from Chevron on top of their own 17.5 cents — which would have been illegal.

After more public meetings and deliberations, the Northern Cheyennes called in an attorney of the Native American Rights Fund in Boulder, Colorado, for advice and to write an environmental code which would protect the reservation. Other attorneys were consulted, and on March 5, postponing further consideration of the Consol proposal with its threat of gasification plants, the BIA was told to declare null and void all their existing coal permits and leases.

Attorney Joseph Brecher of the Native American Rights Fund said that it would be possible for the tribal council to require companies to pay an assessment on mined coal, as well as royalties. Tribal natural resources codes could outlaw mining where revegetation is impossible. Brecher said legal action might also rescind approval already granted by the BIA for existing exploration permits and mining leases. He contends that federal laws were violated when the BIA did not insist on environmental safeguards before approving the agreements.

Brecher, who is a veteran of the Black Mesa legal battles on the Navajo Nation and Hopi Nation, said that plans for Montana and Wyoming indicated "Black Mesa is going to be chicken feed compared with what they are talking about for you guys up here."

At present, the only controls on strip mining on Indian reservations are contained in the BIA's regulations. They lag behind the best state reclamation laws. There is no Federal reclamation law, and the proposed Montana law now before the Legislature in Helena would not apply to reservations.

At the same time, the tribal council implied that if the agency refused to undertake such action, the Northern Cheyennes would consider suing the federal government for not having protected the tribe and its resources, either in the drawing up and approving of the agreements, or in the observance of provisions in the code of federal regulations. The tribal council indicated, moreover, that the Indians might prefer to mine and market their own coal themselves, drawing on independent expertise and with the advice of competent environmental scientists, protecting the reservation with proper planning, regulations, and controls.

Whether the tribal councils could actually get such an operation together is questionable — even the operation of the tribally-owned motel on each reservation has proved troublesome and controversial. Some tribal members worry that the tribal councils are so psychoeconomically tied up in to the BIA that when the pressures are on, it is the voice of the people that will be heard last.

Already the social disruption on the reservation is so great that the people cannot respond well to the threat staring at them — and an influx of money is only likely to add to the social problems. "Some say go ahead, some don't have time to think, some can't think, some don't think, some are still praying, some are still passed out, others are too drunk to talk," a young Cheyenne activist says impatiently.

As has happended on other lands, it is the traditionals — the ones who hold to Cheyenne ways — who have the greatest backbone of opposition to the loss of their land. Tribal elders, speaking in Cheyenne in the presence of the Four Sacred Arrows and the Medicine Hat at a meeting on the Tongue River recently, spoke against selling the land at any price.

"When the Arrow-Keeper, Medicine Hat Keeper, Sun Dance pledges, and traditionally-conscious people of both northern and southern parts of the Cheyenne Nation stand against selling the land, what Cheyenne can stand up and speak from a Cheyenne heart and say, 'Sell the land,' " a traditional spokesman said.

But Vietnam-like, while the tribal demand was being pondered by solicitors of the Interior Department, the coal companies' plans went forward. On March 21st, Peabody announced it would supply 500-million tons of coal from its Northern Cheyenne strip-mine to the Northern Natural Gas Company of Omaha, and the Cities Service Gas Company of Oklahoma City, which jointly would build four gasification plants, at a cost of $1.4 -billion, presumably in the vicinity of the mine. Each plant would employ up to 600 people (meaning an influx of many more non-Indians) and construction of the first plant would start in 1976. Peabody's coal would, moreover, only fuel two of the giant plants — the gas companies would need another 500-million tons from a second mine, which the Cheyennes guessed would be opened by one of the other permit-holders.

Somewhat similar events were transpiring, meanwhile, on the Crow Reservation, which abuts that of the Northern Cheyennes. The Crows had let out permits for 292,680 acres, including rights to the coal in the off-reservation Sarpy area, whose surface the Crows no longer owned. Some of the rights to that had been bought from them for 17.5 cents a ton by Norsworthy & Reger, who had then assigned the rights to Westmoreland — with an overriding royalty of 5 cents a ton which would not be paid to the Crows, but to N&R.

In addition, when making the original deal, N&R had persuaded the Crows that they could not sell their coal unless they also handed over rights to 30,000 acre/feet of water a year (which would be needed for gasification plants). Unknowledgeably, the Crows obliged, transfering one of their water options from agricultural to industrial use, and turning it over to N&R. Altogether, in fact, the Crows gave away to the different coal companies valuable options for 140,000 acre/feet of water per year without a penny of payment.

Testimony by James Reger to the Montana Water Resources Board in Helena on May 20, 1971, relating how he had maneuvered the water from the Crows, angered the Crow People when it came to their attention two years later. Again, the tribe felt that the BIA had not offered protection, and now, as with the Northern Cheyennes, violations were noted in all the permits, and fears were raised for the future of their people.

Early in 1973, lease options were exercised by Gulf and Shell for reservation lands. A report was circulated that a non-Indian city of up to 200,000 people was being considered for the neighborhood of Wyola or Lodge Grass on the reservation. Sentiment for cancelling all the tribe's leases spread rapidly, and the tribal chairman met with attorneys and Montana environmental experts and indicated that the Crows might take actions paralleling those of the Northern Cheyennes.

The resentment of the two tribes could seriously threaten some of the major projects being planned for the heart of one of the principal coalfields. As such, they would prove a significant impediment to the federal government's encouragement of the full-scale exploitation of the Western coal. But there is a still greater threat inherent in the indictment that Indians, once again, were defrauded by their trustee, the Bureau of Indian Affairs, which, abetting the coal companies, opened the reservations to an exploitation marked by unfair terms, lack of protection, and deceit.

Throughout the country, other native people are coming to recognize that the massive nature of the coal developments means the end of the Crow and Northern Cheyenne Reservations as they have been, and with it the almost certain extinction of those peoples as tribal groups. As a result, the situation has a growing significance to all native people, and bids fair to become another source of explosive confrontation between them and the United States Government.

For the Nixon Administration, a likely strategy will be to get into office tribal leaders who will go along with the exploitation as "economic development", which will be pointed to as a worthy example of Indian "self-determination". At stake is the administration's master plan for finding new sources of energy. Nixon has called for step-up in coal production to ease energy shortages.

It is possible that money will talk. The Cheyenne and Crow reservations contain many people living in hardcore poverty. As tribal chairman Allen Rowland says, "So many here have had it hard for so long." The royalty of 17.5 cents for 2 billion tons of coal would work out to more than $116,000 for each of the 3,000 Northern Cheyennes on the reservation — certainly something of a temptation.

To critics of the mining who say the coal companies will "ruin the reservation," some, like 18-year-old Ervin Small, who makes $98.50 per week while he is studying welding, say, "It couldn't be any worse than it is now."

Dilemma 7 — COAL FROM "MOTHER EARTH"

Because of the extreme shortages of natural gas and oil, the Southern Electric Company is considering switching over to cheaper and more plentiful coal as its energy source for producing electricity. A huge deposit of coal that can be easily and inexpensively strip-mined is located on a nearby Indian reservation. If the electric company could gain access to the Indian-owned coal, it could save huge sums of money over what it would normally cost to extract and transport coal from other locations.

The electric company offered the tribal leaders $20 million to lease the land for a period of 10 years. During that time, the electric company would have the right to mine the coal in the area. Although the Indians really don't want to see their land mined, the money would help to provide much needed schools, hospitals and perhaps even jobs for the people on the reservation.

The contracts for the 10-year lease contained a reclamation clause which required the electric company to replant trees and vegetation at the strip mining site. Jane Denison, a young lawyer for the electric company, has carefully researched the reclamation problem. She learned that replanting this strip-mined area would be unsuccessful. The strip mining operation would remove all of the top soil and leave mainly infertile soil and rock in its place. In addition, because the land is so steep it could very easily be worn away. In short, the earth would be left bare and useless.

Jane understands the Indians' feelings toward their "mother earth"; she feels that their sacred land will be ruined forever. Should Jane inform the Indians about the information she had obtained? Why or why not?

SAMPLE OPINIONS

Margaret "No, it's not Jane's duty to tell. The company is working within the strict rules set down by the government and will be complying with those regulations. Besides, the government developed those rules after much study and research. It knows what is good for the country.

Mining the coal will benefit everyone. It will provide the country with its needed electricity and power to run factories. The money the Indians receive will certainly provide them with new living comforts — they can build new homes and buy cars.

One must also think of the future of the country. Coal is our important energy source. We can't allow it to go unused simply to keep the land in its undisturbed state. Why should a small group of people sit on top of a valuable resource that is vital to the needs of the rest of the country."

Eric "Yes. Jane, if she has a conscience, must alert the Indians to all aspects of the lease. Then they can make a truly informed decision. The Indians have been used too long for the advantages of the white man. We can't let these injustices continue. Time and again their lands have been stolen from them.

The very spirit and dignity of the Indian is tied to the land. In fact, the land is part of their religion. To tamper with the land is to tamper with the life of the Indian. It is wrong to ask the Indians to sacrifice part of themselves for the needs of others, especially since Americans consume fuel so wastefully and excessively."

Julie "No, Jane doesn't have to tell. The Indians should know what they are getting into; they have their own advisors. Anyway, they are being paid a large sum of money for the use of the land. They can certainly use that money to improve their standard of living, and coal mining will bring jobs that they don't have now. Who knows, replanting trees might work, or at least different vegetation can be planted.

Jane is an employee of the mining company. That's her first loyalty. If she is always thinking of the other party, she wouldn't be doing her job."

DISCUSSION QUESTIONS

- Jane is obviously being bothered by her conscience. (a) What is the "conscientious" action for her to take? (b) Why should it be important for her to follow her conscience? (c) Should one act on one's conscience even if it means breaking an agreement or law?
- Since Jane is working for the electric company, should her responsibility and loyalty to the company come first? Why or why not?
- Some people hold to the idea expressed by the Latin phrase, 'caveat emptor," meaning "let the buyer beware." Since Jane's job is to represent the company, should she leave it up to the Indians to "beware" of what they are getting into? Why or why not?
- Assuming that the electric company knows that the reclamation program is likely to be ineffective, is it right for them to sign the contract as it is written? Why or why not?
- The Indians will be receiving a large sum of money from the coal mining lease. Shouldn't that be a fair enough exchange for any disturbance resulting from the mining operation? Why or why not?
- Do the Indians have any obligations to help provide the country with coal? We are in the middle of an energy crisis. Shouldn't we develop whatever energy sources that are available to us? Why or why not?
- The Indians believe that man and nature are all one spirit. Would doing harm to the Indian land be in effect doing harm to the Indians? Why or why not?
- We will all benefit from the electricity produced from coal. Should the Indians' feelings about the sacred nature of land prevent us from removing coal from the ground? Why or why not?

Can DDT Solve The Problem?

Reading

Good Words And Bad For DDT: It Saves Lives By The Thousands In Malarial Countries

by James W. Wright

A quarter of a century ago Greece had two million cases of malaria a year; last year it had seven. This decrease is one measure of the largest and most successful public health program ever undertaken: worldwide eradication of malaria. Credit for our success to date belongs to the insecticide, DDT. By spraying it on the inside walls of houses, we kill the mosquitoes that carry the disease, and in doing so we do no significant harm to man or his environment.

Now, though, the supplies of this material with which we are saving lives and improving health are threatened. Because of its indiscriminate use in the past, many are demanding an equally indiscriminate worldwide ban.

Such a ban would make our program forbiddingly expensive. Although we are working on substitutes including other insecticides and biological controls, none of them is ready for large-scale use at a price that the nations in need can now afford. Legislation against manufacture and export of DDT, particularly in the United States, can bring a major international disaster: the return of malaria epidemics — suffering and debilitation from hundreds of millions of cases — deaths from tens of thousands of them.

This malaria program is the most striking of several ways in which the persistent synthetic organic insecticides have brought immense benefits to people in almost every part of the world. During the last 25 years they have been particularly useful in developing countries of the tropics and subtropics. This group of chemicals revolutionized the whole concept of control of disease-carrying insects. For the first time in the history of public health, it was possible to contemplate the control and even eradication of some of the insect-borne diseases that have, for centuries, been insurmountable barriers to social and economic progress.

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Through their use, epidemics of typhus fever, yellow fever and plague are now rare, and those that do occur can be readily controlled: sleeping sickness and river blindness are being cleared from some of the most fertile areas of Africa; diseases such as relapsing fever and hemorrhagic fever are being brought under control in many countries.

In 1945, when control based on spraying of persistent materials was begun, almost 1.8 billion persons lived in malarious areas, the majority in rural communities. To assess the human suffering and death from this disease is almost impossible, but it has been estimated that each year malaria was contracted by 300 to 400 million persons and that it killed between three and four million of these. Losses to agricultural and industrial production are beyond measurement. In 1955 member countries of the World Health Organization (WHO) embarked on a global effort to eradicate malaria. By 1969 this had been achieved in areas occupied by almost 700 million people; eradication programs were being carried out in places where another 700 million lived, and help and advice on eradication were being given to governments responsible for the health of the remaining 400 million who are exposed to the disease. Almost half of the objectives set in 1955 have been achieved and strenuous efforts are directed toward the rest.

These figures become even more impressive when they are related to specific populations. For example, at the end of World War II, the two million annual cases of the disease in Greece resulted in more than 10,000 deaths. A control program was started in 1946, and within three years the number of cases reported each year had been reduced 40-fold to 50,000.

The Republic of the Philippines had 20 million people in 1951 when a survey showed that two million of these suffered from malaria each year, with 10,000 dying from its effects. Absenteeism among students of primary and grade schools was between 40 and 50 percent daily and many large industries reported a 35-percent loss of manpower, practically all of which was attributable to the disease; each year approximately 20 million man-days of labor were lost. Eradication was started in 1957; since 1960 the average number of reported cases has fallen to 40,000 and the number of deaths each year is now less than 1,200.

The most ambitious eradication program in the world is being undertaken in India and is designed to protect more than 500 million persons. Before this campaign was started in 1953, it was estimated that 75 million people suffered from the disease each year; in 1968 the number of cases reported annually had fallen to 300,000. In the fourth five-year development plan for 1969-74 the Indian government has allocated almost $150 million for support of the program.

Unique properties of DDT

Besides these direct benefits to health, malaria eradication has also brought impressive social and economic improvements in many areas. For example, the Terai of Uttar Pradesh in the foothills of the Himalayas has some of the most fertile terrain in India. Before malaria eradication was started, all efforts to settle and exploit it had failed. Today it is one of the most prosperous parts of the country. Malaria eradication in Ceylon also opened large tracts of previously unoccupied land to farming. In one district, over 200 square miles of such terrain was brought under irrigation and was settled by 91,000 previously landless persons.

DDT has made these achievements possible, and there is little hope that global eradication can be brought to a successful conclusion without its continued use. For many reasons, this insecticide has a number of unique advantages.

It is a biological necessity that the female of this mosquito take a blood meal before she lays her eggs, usually by seeking out man in his home during the hours of darkness. In doing so she generally rests on one of the interior wall surfaces of the house, either before or after biting. After feeding on the blood of an infected person, the mosquito must then survive for at least another 10 or 12 days before she can transmit the parasite she has thus acquired to a healthy individual. Internal wall surfaces of all human dwellings in malarious areas are therefore sprayed with an even film of insecticide, enough to kill the mosquito but too little to represent a hazard to man. In countries such as Italy and Greece, where malaria transmission occurs for no more than six months each year, one application of DDT each season is enough; in others, such as the Philippines and India, two or even three applications in each 12-month period are necessary.

DDT spraying for malaria represents little danger to ecosystems. Application is concentrated entirely indoors and directed essentially at the adult female mosquito; as males do not feed on blood, they do not enter houses to any extent and are ignored. Vegetation in the open and streams and pools and other outdoor mosquito breeding and resting places are not treated extensively with pesticides (although draining and sanitizing of breeding areas complements spraying programs). The insecticide therefore does not contaminate the general environment where it might come into contact with wildlife. As it does not in these circumstances contaminate water systems, it can have little effect on food chains and, through them, on higher organisms.

For economic reasons, amount of insecticide and frequency of application are held to a minimum compatible with efficiency. Research has shown that for the most part the insecticide thus applied remains in the body of the treated wall until the DDT breaks down chemically, particularly in homes built of mud and on wall surfaces that are replastered or re-covered regularly for religious or aesthetic reasons.

What are the special characteristics that make DDT so essential for malaria eradication? In the first place it has a marked ability to kill the adult anopheline mosquito. A surface treated with two grams per square meter (a one-ounce whiskey jiggerful will cover a 12- by 12-foot wall) will be lethal for periods up to six months to the intruding female mosquito. No acceptable substitute insecticide has shown itself to be persistent for more than three months.

Deadly to insects; safe for man

In addition it has been particularly favorable from the viewpoint of insecticide resistance. Since the advent of the synthetic long-lasting insecticides, development of resistance has been a major challenge to entomologists. Many important insect species no longer can be controlled with DDT, and this condition has necessitated replacement of this insecticide with other suitable compounds. Notwithstanding the exposure of anopheline mosquitoes to DDT for more than two decades in almost every part of the world, however, only in one percent of the areas treated has this mosquito developed enough resistance to make malaria interruption impossible. The main reason is genetic: DDT resistance in most anopheline populations is recessive. The fact that only female mosquitoes entering houses are exposed to the insecticide is also important. This exposure limitation greatly reduces the selection that is fundamental to emergence of resistance in insect populations exposed to insecticides.

Moreover DDT has shown itself to be remarkably safe for man. Since malaria control was begun in 1945, no toxic effects have been recorded among the 200,000 or more spraymen who have been employed over long periods or among hundreds of millions of people who have lived in houses that have been sprayed for a number of years. These observations are confirmed by extensive health monitoring in DDT factories on persons exposed to massive doses of the compound. Although some of these men had concentration in their fat 50 times as high as that found in the normal U.S. population, their general standard of health did not differ from that of the normal population. In fact the only recorded cases of DDT poisoning have been in persons who had deliberately or accidentally ingested large quantities.

Not least among the advantages of DDT is its low price. DDT is the cheapest residual insecticide yet produced in quantity, and its cost has not varied to any marked degree over the last ten years.

Large quantities of the compound are required annually to meet the needs of the global malaria program. Peak consumption was reached in 1961 when more than 64,000 tons were consumed. Even this affected only 15 percent of total world production. In 1969 the quantity used fell, and the average quantity will continue to fall as eradication is achieved.

Although the insecticide is now manufactured in a number of countries, the major source of the water-dispersible powder essential for malaria work is the United States. This country's unique ability to mass-produce a high-quality product cheaply has been vital to the development and maintenance of the global malaria program. The world is now almost completely dependent on this source of production to continue existing malaria eradication programs at their present level, to consolidate those in which eradication has almost been reached and to begin work in those countries that are still in the planning stage. If U.S.-manufactured DDT were no longer available to the developing countries a critical situation would be created. Development of alternative sources of supply elsewhere would take many years, during which time the lives and health of millions would be jeopardized.

The countries of the world are well aware of this problem and its possible consequences. The concern of India, Indonesia, Nepal, Mongolia, Ceylon, Thailand and Burma — countries in which malaria is still a major public-health problem — was clearly expressed in a resolution passed at the 22nd session of the WHO Regional Committee for Southeast Asia, held at Katmandu, Nepal, in 1969. It asked WHO to request countries producing DDT to continue to do so for the benefit of public-health programs until an equally economical insecticide could be made available in place of this insecticide.

Looking for better methods

WHO is attempting to satisfy the urgent need for new groups of insecticides to meet the challenge of insecticide resistance and to fulfill its duty to prevent environmental pollution. During the past 12 years, in collaboration with the chemical manufacturing industry and through cooperating universities, independent institutions and field research units, it has evaluated effectiveness against insects of more than 1,400 new chemicals, with emphasis on safety to mammals and potential environmental contamination. Now available are several safe, effective and biodegradable compounds that could replace the chlorinated hydrocarbons in controlling almost every insect species of public health importance. Some of these are now in use in malaria-eradication programs in different parts of the world where resistance to DDT has occurred. These insecticides are now 12 to 20 times more expensive than DDT, however. If national health administrations were forced, through circumstances beyond their control, to turn to these new and expensive insecticides, they would be compelled to stop, or at least to reduce drastically, the level of their operating programs. An example of what might occur was recently reported from Ceylon. (I must stress that the situation there was not due entirely to lack of DDT.)

By 1963 endemic malaria had virtually disappeared from Ceylon, and the eradication program had reached a stage of consolidation and surveillance. Because of operational deficiencies, administrative problems, lack of funds and insecticides, and a series of unusual meteorological conditions, a rapid deterioration of the situation occurred from 1967 onwards. Epidemic conditions reappeared, and it has been estimated that during 1968 and 1969 considerably more than two million cases occurred with large numbers of deaths. Similar resurgences, and on a far greater scale, would inevitably occur in other countries in the process of eradication should the cost of DDT rise, or should supplies be cut off or even reduced at short notice.

WHO is also supporting an extensive program on genetic and biological controls that might reduce or even eliminate the use of chemicals for control of disease-carrying insects. With assistance from the U.S. and Indian governments a WHO Research Unit for the Genetic Control of Mosquitoes has been established in New Delhi. During the next seven years it will investigate genetic manipulation as a means of reducing mosquito populations, including the malaria carrier, *Anopheles stephensi*. In West Africa, WHO is also studying hybrid sterility, another genetic technique, as a means of controlling another malarial mosquito. WHO has been exploring predators, parasites, fungi and viruses as disease-carrier controls for ten years and will expand the program considerably in the future. However, it may be as long as ten to 15 years before any of these procedures can possibly be used operationally.

In considering continued DDT use in malaria-eradication programs, one must weigh the possible hazards against the advantages. Thus, in most countries of Europe and North America, where the disease is no longer a serious problem, there is ample ecological justification for limiting its use. On the other hand, in the developing countries of the world, where malaria represents a serious social and economic problem, the continued use of the insecticide will be vital until effective and economical alternatives become available.

It would be tragic if legitimate action is taken by governments to limit the use of DDT interfered with social and economic progress of developing countries. Any action taken to limit availability to these countries for purposes of ecology should be weighed carefully against the sufferings it will bring to millions and the deaths it will bring to thousands.

Reading

Good Words And Bad For DDT: Its Persistency Threatens Disasters To Man And Beast

by Charles F. Wurster

DDT was a product of World War II, introduced when there were few effective alternative insecticides, when insect control was not well understood, when the word "ecology" was almost unknown and certainly seemed unimportant. DDT had been little studied (yet was considered "safe") and many thought DDT would be the panacea that would settle man's age-old struggle against the insects. All of these circumstances have long been reversed. In those earliest years the use of DDT was justifiable, but by 1950 it was apparent to many that its continued large-scale broadcast for a host of real and imagined needs meant trouble. Now, two decades later, the trouble is crystal clear and very serious; yet, as with so many technological "miracles" with a nasty backlash, and entrenched pro-DDT policy continues.

Because DDT travels within the air and surface waters, it does not remain where applied, but gradually becomes distributed to all parts of the world. DDT is quite stable (that is, "persistent"), thus retaining its identity many years after it has been used. As James W. Wright says in the companion article to this one, persistence is a valuable property for malaria control, but it is a double-edged sword. DDT is almost insoluble in water, but because it is more soluble in living tissues, it is accumulated by organisms from their environment. Living organisms for which it was not intended, therefore, become contaminated with a substance that has great biological activity, that affects nerves, enzyme systems and hormones, that can cause cancer and mutations. Thus, DDT is an inherently uncontrollable material once it has been released from its container, and it is senseless to speak of "controlling" its use.

Wright's assertion that DDT presents little ecological hazard when it is applied indoors for malaria con-

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trol would appear untenable. Some of the DDT becomes a gas and forms suspensions in the air when it is applied, thereby escaping into the environment. It is often claimed that residues no longer present at application sites have broken down, but we now know that the material merely disappears from one region only to reappear where it is not wanted. One cannot claim the virtues of persistence for malaria control without recognizing that the material also persists in the environment.

Most of the animals of the earth are now contaminated with DDT and its degradation products, including those that live in remote polar regions and in the oceans. It is present in penguins and polar bears, oceanic fish, birds and whales, in human tissues and embryos, in mothers' milk and cosmetics. The thought is sobering, and we are only beginning to understand its long-term consequences.

The natural feeding habits of an organism largely determine its exposure to DDT. Residues of DDT are passed up the food chain as one organism becomes food for the next. The food material is metabolized and excreted, but the DDT is retained, thereby becoming more concentrated in the higher organism than it was in the food organisms. As DDT passes up food chains, therefore, it becomes more concentrated reaching the highest levels in the carnivorous animals at the tops of these food pyramids. This biological concentration causes top carnivores—various fish, birds and man—sometimes to accumulate concentrations of DDT more than a million times greater than those present in their environment.

During the past two decades certain carnivorous birds have undergone unprecedented population declines. Since 1950 the peregrine falcon, the spectacular bird of falcony since the Middle Ages and a species known for the great stability of its numbers, has declined by 60 to 100 percent in Europe and Russia, by 95 percent in western North America and to extinction as a breeding species in eastern North America. The bald eagle, osprey, brown pelican, Cooper's and sharp-shinned hawks and a number of other species have also been affected. The brown pelican, for example, is largely gone from the Gulf Coast where it was abundant 20 years ago, and the species is declining rapidly along the California coast. The primary problem with these birds is failure to reproduce adequately.

For years these phenomena had no obvious explanation, but during the past five years scientist have solved the mystery. These species feed high in the food chain, and biological concentration leads to high levels of DDT contamination. DDT is an inducer of liver enzymes that break down sex hormones, including estrogen, that are responsible for various aspects of reproduction. With a diminished estrogen supply, the female bird no longer shows normal reproductive behavior. Simultaneously, DDT and its metabolites inhibit the function of the enzyme carbonic anhydrase in the shell gland of the oviduct. Since this enzyme is required for normal eggshell formation, DDT-contaminated birds lay eggs with abnormally thin shells that break prematurely in the nest and produce no chicks. These birds have been laying eggs with shells so thin that they collapse when the adult birds try to incubate them. Nesting areas are sometimes littered with broken eggs, and few chicks hatch. The combined enzyme effects have reduced reproductive success to less than ten percent of normal in some regions, and populations have collapsed. Unless the use of DDT is stopped, we can anticipate suppression to very low levels or extinction of many of the existing species of carnivorous birds.

DDT also reduces reproductive success in fish, but the mechanism is different. As with birds, effects were observed in nature before they were produced under controlled conditions in the laboratory. DDT had been applied to the watersheds of several lakes in New York state, but it was several years before it was realized that DDT had caused the complete mortality of lake trout fry observed in these lakes. There has been no successful reproduction of these fish for a dozen years. Although DDT did not kill the adult fish, it killed the fry soon after they hatched from eggs with DDT-contaminated yolks.

DDT has caused reproductive failure among fish in other areas as well. In Lake Michigan, ten to 50 percent of the Coho salmon fry were killed by the general contamination of the lake with DDT, and abnormal trout fry mortality has occurred in Canada and New Zealand. The concentrations of DDT that have been shown under both laboratory and field conditions to kill fish fry are now being approached, or in some cases are already equaled, in some of our major freshwater and marine fisheries. It is ironic that we are endangering important fisheries that are a source of protein from the sea in the name of insect control on land.

The birds, fish and other organisms that live with man on the earth should be viewed, like the canary in the mine, as monitors of environmental quality. The present, obvious warnings should not go unheeded in favor of short-term, often illusory benefits that can be had by other, less damaging methods. The loss of these predators disturbs ecosystems on which man's ultimate survival and his quality of life depend.

Studies don't tell us enough

Based on observations of prison volunteers and persons occupationally exposed to DDT, much has been said by Wright and others about the safety of DDT for man. Unfortunately these studies have serious deficiencies; they prove only that people are not dying of acute DDT poisoning, nor are they suffering overt toxic symptoms. Only men were examined—no women or children. The number of subjects was too small and the time period too brief to detect long-term, low-incidence damage. Whereas animal experiments indicate that DDT causes cancer and mutations and induces liver enzymes that break down sex hormones, the examinations of the men evaluated none of these factors. Despite Wright's contrary opinion, more rigorous examinations of workers occupationally exposed to DDT in the Soviet Union revealed numerous abnormalities in liver, stomach, kidney enzymatic and neurological functions. It is remarkable that although billions of people have been exposed to DDT for more than 25 years, it has been tested in the United States on only a handful of men.

Because experimentation with human subjects is often difficult or impossible, we must employ laboratory animals as substitutes and consider the results as probably applicable to man. Competent, controlled animal experiments with DDT tell us much about its biological behavior; it is extremely active biologically. Four different studies involving rats, mice and trout have shown that DDT is a carcinogen, that is, a cancer-causing agent. Carcinogenesis in these animals indicates a high probability, but not a certainty, that DDT is a human carcinogen and that the current contamination of the general population is responsible for an increase in the incidence of cancer. This probability is further supported by two studies showing that human victims of terminal cancer contain more than twice as much DDT in their tissues as is found in the general population.

It probably is hazardous to man

Research with rats has shown a mutagenic effect with DDT. As with carcinogenesis, mutagenesis in rats indicates a probability, but not a certainty, that DDT affects human genetics. Some effects of DDT may occur, therefore, in future generations. The induction by DDT of liver enzymes that cause breakdown of steroid sex hormones has been known for more than a decade in laboratory animals, and recently has been shown to occur in man. Although we know that DDT causes increased hormone breakdown in man, we do not know what physiological effect this has. It is strange that experimental results with laboratory animals involving accepted, standard procedures for evaluating other chemical hazards, including those experiments on which pesticide registrations themselves are based, are not accepted by DDT proponents in the controversy over DDT. The principal hazards of DDT to man (carcinogenesis, mutagenesis and enzyme induction) have been ignored and could not have been detected in the primitive studies Wright cites as indicating the safety of DDT for man. Nevertheless, the available evidence implicates DDT as a health hazard in the human environment.

Decision makers should evaluate both the benefits and risks of a pesticide. While the risks of using DDT are increasingly apparent, the benefits are frequently illusory, diminishing but exaggerated by DDT proponents, and attainable by alternative procedures. Although Wright disagrees, many say that insect resistance to DDT has become a severe problem. When heavy mortality is imposed on an insect population, a small percentage survive because they have traits with survival value. They repopulate the region, and the protective traits become more prevalent. Repetition of this process generates resistant populations that can no longer be killed by the original insecticide or dosage. Resistance has rendered DDT ever less effective over the years.

Resurgence is a more serious problem. Even in the one-crop cultivations of modern agriculture, insects live in complex communities involving hundreds of species. Predatory and parasitic insects usually keep the plant-eating, potential pest insects under biological control so that only a very few reach pest proportions and require artificial suppression. The use of a broad-spectrum poison such as DDT kills all insects, creating a biological vacuum. With ample food (plants) available to the herbivorous insect survivors, the former pest species, or a new one, resurges in the absence of its natural enemies to levels far greater than existed before the DDT treatment. In this way, DDT often aggravates the very insect pest problem it is intended to solve; it creates the illusion that more DDT is needed to alleviate a pest problem that DDT itself has caused. DDT is an ideal product for the manufacturer because its use often generates the apparent need for more of itself.

Despite emotional appeals about the need for DDT in food production, less than one percent of the food crop acreage of the United States is treated with DDT. About half of all the DDT used in this country is applied to cotton where tolerance limits do not apply; resistance and resurgence problems have led to ever greater dosages of DDT, with associated lower profits to cotton farmers and increased environmental contamination. Entirely too often farmers seek advice on insect control from pesticide salesmen rather than from competent and impartial entomologists.

Modern agriculture cannot afford the numerous problems and high costs of a pure chemical approach to the control of insect pests. A sounder solution that avoids most of these problems, being both effective and economical, involves integrated control, where chemical and biological techniques are ecologically blended into a compatible system. Such insecticides as methoxychlor, Dibrom, Abate, Sevin, malathion, Dipterex, chlorthion, dimethoate, ronnel, diazinon, pyrethrum, rotenone, Sabadilla, ryania, dichloroethyl ether, various petroleum oils and many others are used only when and where necessary in minimal amounts and in such a manner as to preserve as much as possible those beneficial biotic agents (parasites, predators and organisms that cause diseases in insects) that aid in controlling the pest species. DDT plays no role in such a program because it is persistent, broad spectrum and therefore highly disruptive within an agricultural ecosystem. Insecticides such as those mentioned are effective and less disruptive, and because they are nonpersistent, they do not contaminate and threaten nontarget organisms in that part of the environment that is nonagricultural.

DDT has played a vital role in malaria control in many parts of the world, though again its benefits are often exaggerated. Malaria was declining rapidly in the United States before the DDT era began, but DDT aided in eradicating the remainder. The only malaria now present in this country is that brought in from other parts of the world, and this can be controlled by methoxychlor, malathion and various non-chemical techniques, should it show signs of spreading.

In other parts of the world, DDT is no panacea to malaria control. Malaria cannot be eradicated from the earth by DDT or any other known device. Only new discovery from continued research can achieve that objective. DDT successfully eradicated malaria from those regions where the job was relatively easy, as in Greece, whereas in more difficult areas such as Africa there is as much malaria as before. Because of resistance and other factors, malaria has resurged in many parts of the world in spite of, and sometimes even because of, the use of DDT. Only in those malarious underdeveloped countries that for economic reasons can afford only DDT in their control programs does the continued use of DDT carry benefits that remain greater than the risks. The rest of the world can achieve its benefits by a host of alternative techniques —some already available, some yet to be developed— and can no longer afford its great risks.

Although DDT use in the United States has been neither necessary nor desirable for years, effective limitations have not come from the United States Department of Agriculture. Headlines tell us that DDT has been banned, but substantive action is lacking, and DDT continues to be poured into our environment. The DDT problem is a symptom of a greater disease in which the regulatory structure is more responsive to the industry it is supposed to be regulating than it is to broader environmental considerations. There will continue to be nightmarish pesticide problems until this central regulatory deficiency is recognized and alleviated.

(The Department of Agriculture says it is now preparing a cancellation notice, and a suit is pending against it that demands a complete ban.)

DDT is usually considered a cheap insecticide; at 17 cents per pound it is the cheapest insecticide on the market. Costs, however, must be measured, not in cents per pound, but in effective and safe insect control. Not only is DDT often ineffective in controlling insects, but also DDT proponents regularly forget the other cost of DDT—the irreparable environmental damage it is doing. Using this measure, DDT has become the world's most expensive chemical.

Dilemma 8 — CAN DDT SOLVE THE PROBLEM?

The country of Sarton broke off friendly relations with the United States several years ago when its new government took office. Since then the United States has stopped providing all aid to Sarton — including aid for its malaria prevention program.

This year malaria has reached epidemic proportions in Sarton, and thousands of people are dying from the disease. To control the spread of malaria in their country, local officials in Sarton want to start a DDT spraying program. This will require 600 tons of the chemical at a cost of $1 million. Sarton, however, is a very poor country and cannot afford the $1 million to buy the DDT.

Although the United States banned the general use of DDT in 1972 after recognizing its dangers, several companies still continue to manufacture this pesticide for use outside of the country. Many countries throughout the world feel that despite its health dangers, DDT is important because it is inexpensive and yet very effective for protecting crops and ridding of many kinds of disease carrying insects and rodents.

Should the United States ignore its own policies and the health hazards posed by DDT and offer to supply the chemical to Sarton? Why or why not?

SAMPLE OPINIONS

Paul "Of course the United States should give the DDT to Sarton. After all, what would a mere $1 million mean to a country as rich and powerful as America. Certainly, if we needed help we would expect others to help us. Besides, what would the rest of the world think of us if we refused a country — even an unfriendly one?"

Lee "No, we shouldn't give the DDT to Sarton. We banned DDT in America because it was a health hazard and could endanger living things of all kinds. Sarton obviously does not recognize the long-term detrimental effects of DDT on living organisms, including human beings. Using DDT would result in many unknown risks to nature. The natural system involves plants and animals depending upon one another. Upsetting one part of the system can have serious effects on many other parts. I don't think we should take the chance in using DDT which can threaten so many forms of life."

Barbara "No, I don't think that the United States should help Sarton. Rules are rules. If the United States won't allow DDT to be used here, how could we allow others elsewhere to use it. That would be hypocritical. We are world leaders — looked up to by most countries in the world. So, we must take an international stand on the issue of DDT. If it's dangerous for us, it's dangerous for others. Therefore, it's our duty to safeguard the health of others in the world."

DISCUSSION QUESTIONS

- In light of the devastating effects of malaria, shouldn't government leaders try to quickly eradicate the disease and suffering and then worry about the effects of DDT later? Why or why not?
- If a country knows about the hazards of a toxic chemical, should it allow other countries to use the chemical? Why or why not?
- Should each country have the right to decide what is best for itself? Why or why not?
- If the harmful effects of DDT are spread to other countries, who should be responsible for the damages? The country producing the chemical? The country who uses it? Why?
- Since many other countries use DDT for pest control anyway, why should Sarton be prevented from using it?
- If DDT is the most practical way to prevent the spread of malaria, is this not the best reason for using it? Why or why not?
- Considering the possible effects of DDT on future generations of people and animal life, can the United States in good conscience refuse to send the DDT? Why or why not?
- If the U.S. is so concerned with the dangers of DDT, shouldn't it ban companies from producing and exporting it? Why or why not?
- Since there are safer but more expensive ways to rid mosquitoes, shouldn't the U.S. offer to provide the new pest control materials? Should U.S. taxpayers be expected to pay for this? Why or why not? What would happen if other malaria endemic countries also request this type of aid? Why?
- In making its decision, what important factors should the U.S. consider? Why?

What Do You Do With Waste Chemicals?

Reading 1

Deep Well Wastes May Be Water Hazards

The unrestricted dumping of sewage and chemical wastes deep into the earth might not be such a good idea, a new study finds. Strict surface water pollution laws have left more and more cities and industries with big waste disposal problems. Many have tried injecting liquid wastes into 1,000-foot wells. More than 300 such wells had been dug at last count, in fact. At those depths, the wastes often flow into aquifers, porous water-holding rock formations. But a team of hydrologists now reports that these wells may be a hazard to subsurface environments and may damage both the aquifer formation and the potential drinking water sources they contain.

Hydrologists Jerry A. Leenheer, Ronald L. Malcolm and William R. White of the U.S. Geological Survey in Lakewood, Colo., made a case study of wells dug by a North Carolina chemical company. Hercules, Inc. of Wilmington, N.C., a producer of polyester fiber feedstocks and explosives, dug a deep waste well several years ago for liquid wastes, mostly acetic and formic acids. Early clogging problems attracted the team of government hydrologists and the company agreed to dig 14 observation wells at sites near the original so the team could monitor water flow and chemical changes at various distances from the point of initial waste discharge. They found several evidences that the dumped acids were unstable and reactive underground, quite in contrast to the common assumption that injected wastes do not react or pollute subsurface waters.

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During their three-year study, the team reports in the May *Environmental Science and Technology*, they detected original wastes and reaction by-products in the observation wells 1,400 to 2,700 feet from the injection well. There was evidence, Malcolm told *Science News*, that the acids were causing clay minerals and iron oxides from the aquifers to dissolve and move away through the underground formation. As the water migrates and its initial acidity decreases, he says, these dissolved inorganic constituents reprecipitate, forming a gel-like material that plugs the pores of the aquifer. Not only does such chemical activity tend to ruin the aquifer formation, Malcolm says, but wastes could migrate and break through into zones of drinking-quality water, destroying their future ability.

"There has been such a long history of water flooding to bring oil to the surface, then reinjecting the brine in deep wells, that it has influenced the whole philosophy of deep water disposal. They figure," says Jerry Leenheer, "that if brine is OK, anything is OK. That's why subsurface chemistry has been ignored."

The team recommends initial testing to determine the compatibility of the wastes with aquifer water and sediments from a proposed well site. If adverse chemical reactions occur during testing, the wastes should be pretreated and injected in a form that will not harm the environment, they advise.

Reading 2

Designing The Perfect Landfill

by A. Blakeman Early

Three methods are commonly used to dispose of solid wastes generated by homes and offices: ocean dumping, incineration, and landfilling. Ocean dumping is being phased out under Environmental Protection Agency (EPA) regulations authorized by the Marine Protection, Research, and Sanctuaries Act. High costs are helping to diminish the use of incinerators. Thus, the bulk of the solid waste disposal burden now falls on landfills.

An informal telephone survey carried out recently by *Waste Age* magazine revealed that in 37 states there are 18,539 known land disposal sites. Of these only 5596 were labeled as "sanitary" landfills. This term varies from state to state, but basically it implies a preplanned, well engineered operation designed to compress garbage, spread it thinly, and cover it with a layer of dirt.

Properly designed sanitary landfills can minimize threats to public health and safety and to the environment. Scientifically selected, engineered, and contructed sites also avoid cleanup costs incurred as a result of reckless open dumping. Moreover, unlike open dumping, sanitary landfilling can eventually put the land back to work for low-density residential or recreation use.

Improper land disposal leads to rats, flies, and other disease carrying agents which spread pathogenic disease through the scavenging activities of people and animals. Uncontrolled fires in landfills can cause property damage and air pollution. Under certain conditions carbon monoxide and methane gas can escape from landfills and "migrate," creating the danger of explosions of human and animal suffocation. Finally — and probably most significantly — surface and ground waters can be polluted by chemicals and other sub-

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stances leached (absorbed by water) from the refuse dumped in the carelessly supervised landfill.

Although the first three of these hazards can be prevented to a large extent simply through compacting and covering the wastes daily, the last two cannot. Only through sophisticated sanitary landfilling techniques such as lining the landfill site with impermeable materials — a step taken at only 21 of the over 18,500 documented land disposal sites — can contamination of water supplies be avoided.

Most of the data available on leachate concerns only its composition prior to dilution or attenuation through underlying soils. (Attenuation is the term given to several chemical, physical, and biological processes which filter leachate as it moves through the soil.) The composition of leachate varies according to the types of waste in the landfill, the age of the site, and temperature and moisture conditions. Nevertheless, the EPA has compared average pollutant levels in leachate to typical domestic sewage and found that they exceed concentrations in sewage by 700 times for maganese, 500 times for iron, 13 for chloride, six for nitrogen, and 50 for biological oxygen demand.

Damages resulting from leachate rarely involve human injury because by the time drinking water is contaminated it is usually objectionable in color and odor. Thus, a built-in warning system usually prevents poisoning. But other problems arise.

Although limited data exists concerning leachate contamination of surface and ground waters, a clear pattern emerges from the data which is available. A substantial number of the reported incidences involve the disposal of industrial chemical wastes at landfills which are designed to accept mixed municipal waste and which may not be well designed even for that. Had these industrial wastes been directed to sanitary landfill sites specifically designed and engineered for such wastes, many of the ensuing problems could have been avoided. The most dramatic damage case reported to date involves a municipally owned landfill which also accepted industrial wastes and was in operation only eight years. Four years after the site was closed, leachate was found to be threatening an underground aquifer not only serving as a drinking water supply for over 40,000 area residents but also needed for industrial use. According to recent estimates, up to $26 million will be required to stop further deterioration of the aquifer. It is indeed fortunate that the landfill site is owned by a county government, for there is a serious doubt whether a private owner could be held accountable for such damages, assuming the site was operated under existing state and local permits.

The most common strategy for controlling leachate is to minimize the amount of surface and ground water infiltrating the site. This means diverting nearby surface and ground waters, carefully choosing impermeable cover materials for the landfill, taking steps to compact and slope wastes, and minimizing the period during which wastes are exposed to the elements. State regulations frequently provide for a minimum distance which must be maintained between the bottom of the landfill and underlying ground water so escaping leachate may be absorbed or attenuated by underlying soils. The slower the flow of leachate or the greater the volume of soil it must penetrate, the longer these processes are at work and the more effective they will be.

Where natural soil conditions are unsuitable for attenuating pollutants from leachate emissions, and alternative strategy is to line the bottom of the landfill, collect the leachate and treat it before it escapes to surface or ground waters. The variety of constituents and concentrations in leachate pose a significant challenge in selecting a liner which will withstand corrosion and other degradation. Suggested liner materials range from various asphalt materials, polyethelenes, and plastics, to dense forms of clay.

If solid waste could be completely enclosed by impermeable materials, obviously all leachate contained in the waste would be locked in. Some planners believe this is possible but it would require development of impermeable materials able to withstand the corrosive properties of the leachate over long periods of time. Research is underway to determine the relative merits of various proposed liner materials.

The last hazard associated with landfilling is methane and carbon monoxide gas. A product of the natural decomposition of refuse in a wet environment devoid of oxygen, these gases are produced by all landfills in concentrations reaching explosive levels. Lethal concentrations of the gases can migrate in the air either laterally or vertically great distances from the site. Many cases of property damage and human injury from gas explosion or inhalation have been documented. Obviously these gases would cause problems if impermeable liners were used to contain wastes and leachate. Venting with trenches or pipes to avoid explosions is necessary to prevent gas flow to adjacent areas.

Because of poor documentation, reports of damages resulting from improper land disposal of mixed municipal waste represents only a small part of the total damages and a fraction of future damage potential, especially given projected growth in waste generation and increasing reliance on land disposal. Greater use of the strategies described above could substantially reduce present and projected damages.

Furthermore, greater use of sanitary landfilling also would help "internalize" the true cost of waste generation. The higher costs of a sanitary landfill reflect the true impact of generating so much solid waste that it threatens public health and the environment. If higher costs could be imposed on waste producers they would then be motivated to reduce the amount of waste destined for disposal either by reducing it at the source, reusing it, or recovering it for reprocessing before final disposal. Unfortunately, adequate facilities are very expensive and it is frequently much cheaper to compensate those who can show damages from improper land disposal than to build proper landfill sites to begin with. We must recognize that proper land disposal is essential, that it will be more costly than current practices, and that the only way to reduce this expense is to curtail waste generation at the source.

Reading 3

— An Alternative To Our Deadly Dumps

by A. Blakeman Early

Industrial processing wastes have traditionally fallen outside the municipal collection and disposal system, except to the extent that, for a fee, certain municipal land disposal sites accept both mixed municipal and industrial wastes. Since federal legislation is beginning to limit ocean disposal, landfilling and ponding will continue and grow as the principle methods of disposing of hazardous industrial wastes. Unfortunately hazardous waste disposal takes place with little or no regulation to protect human health and the environment. Only 14 states have regulations which require hazardous wastes to be handled separately from mixed municipal waste. Consequently, economics largely determine the disposal method used.

Industrial wastes contain hazardous chemicals belonging to the following categories: toxic metals (arsenic, chromium, lead, mercury, cadmium), toxic anions (cyanide and fluoride), and a variety of toxic organic chemicals (pesticides, polychlorinated biphenyls, chlorinated hydrocarbons, industrial solvents).

Although little is known about the volumes of such wastes being generated and disposed nationwide, it is expected that as the nation moves toward implementation of more stringent requirements governing the discharge of toxic pollutants into the air and water, the volumes of air and water pollution control sludges will add significantly to such wastes. The Environmental Protection Agency estimated in its 1973 Report to Congress on Hazardous Wastes that out of a total of 110 million tons generated by industrial processes, approximately 10 million tons were being land disposed annually. New estimates now place the total industrial waste volume at 260 million tons annually. Although no determination of the hazardous portion has been made,

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an assessment of just three industry categories has shown an annual generation rate of approximately 8.3 million tons. It can be assumed that a much larger amount of hazardous wastes are posing a potential threat of human, environmental and property damage than previously estimated.

This crisis in toxic wastes management is typified by several case stories.

In 1971, a major chemical company contracted with a trucker to haul approximately 6000 drums of petrochemical wastes to a landfill. The trucker took a shortcut and transported the drums to an abandoned chicken farm in New Jersey, where they were stockpiled and subsequently emptied. Within two years, a major aquifer was contaminated resulting in the condemning of 150 private wells. The cost of extending public water supplies into the area came to roughly $300,000. Moreover, the dumping incident reduced local building and development. The exact magnitude of the environmental and economic damage has not yet been determined.

- Between 1965 and 1969 a company in Pennsylvania extracted copper from industrial wastes, storing the remaining liquids in 11 cement lagoons. Three lagoons developed open seams and toxic pollutants began seeping into an adjacent creek, which feeds into the Delaware River system, turning it into a lifeless sewer. Rather than pay the expense of correcting the leaks, the company abandoned the site, leaving behind lagoons filled with 3,500,000 gallons of toxic wastes as well as rusting drums of wastes scattered elsewhere on the property. In April 1970, county officials sandbagged the area and built a dirt dike to prevent heavy rains from washing the wastes directly into the creek. Ultimately, the state paid the cost of neutralizing the wastes and dumping them at sea. Cost: $400,000.
- In October 1968, a waste storage lagoon containing oils, acid wastes, and alkyl benzene sulfonate ruptured, spilling a toxic sludge into a creek which flows into the Allegheny River. An estimated 4.5 million fish (valued at $108,000) died. The company abandoned the facility two years later, leaving the state of Pennsylvania with a $20,000 clean-up bill.

These are stories of blatant toxic wastes pollution, but they comprise only part of the story. In attempting to grapple with the complex business of hazardous industrial waste disposal, the Environmental Protection Agency and state governments have made the inevitable realization that in most cases hazardous pollutants manifest themselves in insidious chronic effects that are almost impossible to trace. Only in rare instances of chronic poisoning is a positive correlation of cause and effect possible.

Even those industrial wastes that are relatively insoluble ultimately find their way into surface streams by overflow or seepage through dikes. Quite often, the dumping of hazardous wastes on land results in ground as well as surface water contamination.

As a result of burying arsenic-containing pesticides in Minnesota in the late 1930s, 11 persons in 1972 developed arsenic poisoning from drinking contaminated well water. Two of the victims required hospitalization.

A New York electroplating firm has been discharging its waste water into unlined "settling ponds" since the early 1940s. Although effluents have been chemically treated since 1958, local groundwater supplies were recently diagnosed as a contaminated with toxic cadium and hexavalent chromium.

There are relatively few reported incidents of air pollution arising from land disposal of hazardous wastes. Nevertheless, the air surrounding land fills can be seriously damaged in a number of ways.

One case in point relates to the land disposal of hexachlorobenzene (HCB) in Louisiana in 1973. HCB, a toxic, solid byproduct in the production of perchloroethylene, was dumped in a rural landfill, where it evaporated. Meanwhile, HCB entered the air from the manufacturing plants themselves and from wastes spilled by the trucks that hauled wastes to the dump. The HCB ultimately was absorbed into the body tissues of cattle. As a result, approximately 20,000 head of cattle had to be quarantined by the Louisiana Dept. of Agriculture at a loss to ranchers of over $3.9 million. Sampling and testing alone cost the state and federal governments over $150,000.

It is particularly difficult to identify and confirm contamination of the food chain by land disposal of wastes due to the lack of laboratory evidence. For example, available data is inadequate in determining the number of years before various food crops can be safely harvested on farmland poisoned by hazardous wastes.

Nevertheless, in 1969 three children sustained serious alkyl mercury poisoning after eating contaminated pork from pigs raised on their family's land in New Mexico. A fourth child suffered congenital mercury poisoning because his mother consumed tainted meat during pregnancy. Hogs had been fed grain treated with methyl mercury type seed dressing. The grain originated from a seed company where the children's father gathered floor sweepings at no charge and fed them to his hogs. While this tragic story is not specifically related to land disposal, about 100 bags of similarly treated grain were subsequently discovered at the community dump in another New Mexico town. Public Health authorities established that some of this dumped grain (originating from a different source than in the previous case) was scavenged and used as animal feed. As a result of the uncontrolled dumping, a number of hogs, chickens, and other animals had to be quarantined.

When hazardous wastes of a chemically reactive, incompatible nature mix, we can expect the eruption of fires and explosions. Any landfilling of unidentified chemical wastes is a violation of common safety principles, as a number of landfill operators who have suffered from disposal mismanagement can attest.

Environmentally sound hazardous waste management is costly, but in the long run, when measured in terms of public health and protection of the environment and private property, it is cheap.

Clearly, the magnitude of the hazardous waste disposal problem warrants federal attention since most states readily admit an inability to control landfills. Though Congress has had various forms of waste control legislation before it for over two years, it has failed to even bring a measure to a vote.

Dilemma 9 — WHAT DO YOU DO WITH WASTE CHEMICALS?

Robert Hughes became concerned about the dumping of industrial chemical waste into deep wells close to the major river of his state. He began searching for a more environmentally safe way to dispose of these wastes. Together with a soil researcher, he developed a biodegrading technique that used soil to break down chemicals into safe compounds. He then formed a company, purchased 6000 acres in the desert, and secured a contract with a chemical company to haul away and dispose of its toxic wastes.

Soon after he began hauling the chemical waste to the disposal site, the state enacted new rules for the storage and disposal of hazardous chemicals. The new rules required that companies handling hazardous chemicals obtain a license for $5,000 and post a $200,000 cash bond. Mr. Hughes did not have such a large sum of money. Moreover, it turned out that the chemicals were so highly toxic that a much more expensive technique was required to detoxify the materials. Under these new conditions the company could not operate.

Mr. Hughes now had 600,000 gallons of very poisonous chemicals in metal drums standing in the middle of the desert. Since he did not have a license to dispose of the waste by his new "soil" method, the state ordered him to bury the waste in underground trenches within one week. The state claimed that it was safe to bury the waste. Mr. Hughes, however, was sure that the chemicals would leak into and poison underground fresh water reservoirs.

Should Mr. Hughes comply with the state orders? Why or why not?

SAMPLE OPINIONS

Marion "Yes, what else can he do? If that's what the state orders, then it is his duty to comply. They left him with no other alternative. He doesn't have the money for the expense of using the biodegradation method. He should do what the state officials ordered and leave the rest up to them. It's no longer Mr. Hughes' problem. It will be the state's responsibility if anything happens now."

Bill "Yes, Mr. Hughes should do what he was told by the state officials. The state made the laws and they are charged with enforcing those laws. Mr. Hughes, if he is to be considered a law-abiding citizen, has no choice but to obey the laws of the state. What if Hughes disobeyed the state's order? Maybe that wouldn't be too bad. But what if everyone did it? You see, Hughes would be setting a bad example. This order was given to prevent dangerous materials from causing injury. The law is always right."

Pete "No, I don't think that he should obey the law. While rules or laws are usually fair and made to protect people, sometimes certain laws are not made wisely. In this case it is obvious that the state does not understand nor recognize the danger to human health that dumping the chemical will cause. I think the state officials are acting hastily in this situation. If Mr. Hughes thinks that there is a chance that the buried chemicals could poison the waters, he should not comply with the order. What is more important than to try to protect the health and safety of people?"

DISCUSSION QUESTIONS

- In terms of society's welfare, which would be worse: disobeying the law or burying a chemical in a way that might be harmful? Why?
- Since Mr. Hughes owns the land, shouldn't he be allowed to do what he wanted on it? Why or why not?
- If the chemicals should leak into the fresh water reservoirs who should be blamed? The chemical company? Mr. Hughes? The state? Why?
- Isn't the state trying to protect people from unsafe disposal of chemical waste by imposing such a law? Why or why not?
- If Mr. Hughes was so concerned about toxic chemical waste, shouldn't he try to raise money for a license? Why or why not?
- Since Mr. Hughes' intentions are so good, do you think that the state should consider allowing him to operate without paying for a license and a bond? What would people think about laws if the state made an exception for Mr. Hughes and allowed him to operate without a license? Why?
- If a person takes on a responsibility should he/she try his/her best to complete it, no matter how difficult? Why or why not?
- If Mr. Hughes defies the state order, should he be sentenced to jail? Why or why not? What effect would that have on society?
- What should be Mr. Hughes' most important consideration in making the decision? Why?

PVC: Versatile But Dangerous!

Reading 1

A Plague Of Poisons

by Mark Wexler

We've barely scratched the surface of the toxic substances problem, but for too many Americans time has already run out.

While Americans were celebrating the nation's 200th birthday a few years ago, a different bicentennial slipped by unnoticed: the anniversary of the discovery of occupational cancer. In 1775, a British surgeon named Percivat Pott became the first scientist to link tumors in chimney sweeps with their exposure to coal soot. Pott's observation was an ominous harbinger. A century later, as the Industrial Revolution shifted into high gear, chemically caused illness at home and at the work place became a terrifying fact of life. It still is today.

Many of the nineteenth century's industrial maladies have been all but wiped out. Americans now live longer and better than ever before. Ironically, however, some of the same products, by-products and processes that have improved our standard of living also present a constant hazard to human health. Chemicals used in everything from talcum power to electric hair dryers are associated with a whole new witch's brew of problems. Many of these substances are barely detectable in humans, yet only a minuscule amount can cause irreparable damage.

Perhaps the most alarming aspect of these modern poisons is their insidious and persistent nature. In Michigan, for example, officials are still discovering new victims of a 1973 incident in which a fire retardant, polybrominated biphenyl (PBB), was accidentally mixed with animal feed. The resulting contamination has affected thousands of domestic animals and possible millions of Michigan residents.

In Illinois, University of Chicago researchers have reported that traces of asbestos — a mineral long suspected of causing cancer — can be found in 96 percent

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of all U.S. urban dwellers. In northern Alabama, some residents were warned recently not to eat fish caught locally, because the creatures contain dangerous levels of the pesticide DDT, which has not been sold in this country since 1973. In Virginia, another pesticide, Kepone, has so tainted fish and oysters in the James River that fishing is no longer permitted there. "It used to be that you could immediately see signs of toxicity in a river," says New York official Salvatore Pagano. "We didn't realize then that there were residual chemicals that didn't bother the fish at all but did kill people."

Because so many poisons are so insidious, we may have only begun to gauge their full effect. Since 1900, cancer has climbed from the eighth leading cause of death in the U.S. to the second. One out of four Americans now develops some form of the disease; one out of five dies from it. This is no doubt at least partly due to the fact that we live longer these days. But cancer is not necessarily an inevitable disease. Many experts are convinced that between 80 and 90 percent of all human cancer is triggered by exposure to toxins in the environment. Unfortunately, since the latency period for some cancers is as long as 40 years, some scientists believe that we may be on the verge of a chemically induced "cancer epidemic." The reason: most manmade toxic substances have only been in production since the end of World War II.

While many of the 70,000 chemicals currently in wide use may be relatively harmless, fewer than ten percent of them have actually been tested for potential dangers. "There are an awful lot of substances out there that we know very little about," says Douglas Costle, administrator of the U.S. Environmental Protection Agency (EPA). One reason for this is that the tests commonly used for some chemicals are both time consuming and expensive, often costing as much as $200,000 per chemical. But, says Thomas L. Kimball, executive vice president of the National Wildlife Federation: "The EPA puts too much emphasis on the potential cost of testing — which is borne by the manufacturers — and too little on the costs of illness, death and environmental degradation, which are borne by all of us."

Even when a chemical is known to be poisonous, there are often major obstacles to protective measures. At present, at least 20 different federal regulatory statutes, administered by six different agencies, deal with toxic substances. The keystone of the government's efforts is the Toxic Substances Control Act of 1976. This law gives the EPA power to regulate any chemical that poses a public risk. In effect, it empowers the agency to regard all such substances as guilty until proven innocent. But the job of implementing the law has proven a bureaucratic nightmare and thus far only a few chemicals have been banned or restricted.

In addition to testing thousands of chemicals, the EPA faces another monumental task: resolving the question of what to do with the 40 million tons of hazardous wastes generated in the U.S. every year. Less than 20 percent of these wastes, the EPA estimates, are being disposed of properly. That means more than 30 million tons of poison may be seeping into the land and the water annually. Unfortunately, the agency does not yet have an effective national program for identifying dangerous dumping grounds. "We have a chicken-and-egg dilemma," says solid wast official Thomas Jorling. "We don't have enough resources to identify the problem — but before Congress can act, we have to know the extent of the problem."

Last fall, the EPA reported that there may be as many as 32,000 potentially dangerous waste sites. The cost of cleaning up all of them may exceed $50 billion but, hamstrung by the Carter Administration's limit on spending, the EPA cannot even begin to tackle this task. The situation is symbolic of a much larger problem. Although Congress has given the EPA the laws it needs to deal with toxics, it has consistently refused to provide the money required to implement those laws.

"We look back on the Middle Ages and say, 'No wonder they had black plague, they used to throw their garbage in the streets,'" Douglas Costle reflected not long ago. "Now, I just hope that in the year 2025 my grandchildren don't look back on this generation and say, 'No wonder they had problems look at all the chemicals just carelessly introduced into the environment, uncontrolled.'" As the five stories on the following pages amply demonstrate, we should have begun wondering about that a long time ago.

Reading 2

Vinyl Chloride: Time Bomb On The Production Line

by Don A. Schanche

Until last January, not many Americans had ever heard of vinyl chloride and even fewer knew that it was deadly The cheap, colorless gas is one of thousands of little-known substances that go into the making of industrial and consumer products.

You probably have encountered the gas unknowingly if you have used spray paints and insecticide aerosols, or if you used certain hair sprays, in which vinyl chloride served as a propellant. (However, a marketing ban has been imposed against these products.) A far more common use of vinyl chloride (VC) is as a base for solid and flexible plastics. Some 6,500 United States workers are involved in producing the gas and its polymerized form, polyvinyl chloride (PVC), which is a hard, granular resin. PVC is used in making about half of all our plastics — food wrappings, bottles, water pipes, blood storage bags and tubing, car upholstery, fabric coatings, wall and floor coverings, and thousands of other common objects. Unless you live in a plastics-free environment, you probably can reach out and touch a PVC-based product as you read this. But scientists have reassured the public that there appears to be no danger of toxic exposure from polyvinyl-chloride-based consumer products.

However, some Americans are not completely reassured . . .

A cluster of cases which proved alarming centered in upstate New York. These were three angiosarcoma deaths apparently having no connection with occupational exposure to VC. All of the victims were women who lived in the Buffalo-Niagara Falls area. Investigators may never be sure why these women died, but the extraordinary coincidence of three such "rare cancer" deaths occurring in the same small area strongly suggests that they died simply from breathing the local air

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[1] This excerpted selection is reprinted by permission from *Today's Health* Magazine, September 1974, pp. 16-19+. Copyright September 1974 - all rights reserved.

— air poisoned by VC gas escaping from a Goodyear factory.

According to the Environmental Protection Agency, about 300 million pounds of vinyl-chloride gas — out of a total of 5-to-6 billion pounds produced each year — escape into our atmosphere. But the EPA is working to establish stricter air quality and emission standards for the industry. By October, the Department of Labor expects to set new plant exposure levels for those who work with the gas and its resin. Still, there are those who say we have only begun to see the results of this chemical killer.

"The industry is a relatively young one and the effects of toxic exposures are only beginning to appear," says Irving Selikoff, M.D. director of the Mount Sinai Environmental Science Laboratory. "Most of our experience is ahead of us."

Medical scientists, such as Dr. Selikoff, generally are reluctant to speculate on the future. Nonetheless, Dr. Selikoff and others have urgently asked for strict controls governing the escape of the gas and the exposure levels in the industry.

"We have learned from other industrial carcinogens (cancer-causing agents) such as beryllium and asbestos that the hazard might not stop at the factory gate, that it might invade the workers' homes and the neighborhoods near the plants," explains Dr. Selikoff.

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Dilemma 10 — PVC: VERSATILE, BUT DANGEROUS!

The New Line Company is a large producer of polyvinyl chloride, an important chemical in the manufacture of many plastic products.

Early this month, 300 of the 500 employees working at its Great Falls plant went on strike because the company would not agree to their request for a wage increase and extra benefits. Management felt that it could not afford to give in to the union demands in view of the higher prices for energy and raw materials. During the strike, supervisors, assistant managers, and clerical workers took over plant operations.

In the manufacture of polyvinyl chloride, vinyl chloride escapes into the air. The chemical is linked to lung cancer and defects in newborn babies. In the interest of safety, the Health and Safety Agency has required the New Line Company to install an alarm system to alert the workers when escaping vinyl chloride gas reaches the danger level.

During the first day of the strike the alarm goes off 22 times. The managers and supervisors realize that they lack the training to quickly locate the problem and properly repair the equipment. Fearing that the alarm will go off so often that he may be forced to close the factory, Mr. Farber, the plant manager, turns off the alarm system.

The strikers picketing outside the plant notice that the alarm does not go off as regularly as it usually does. They sense that something is wrong and alert the Health and Safety Agency. Mr. Farber, however, turns on the alarm system just as the inspector arrives. Finding nothing wrong, the inspector then leaves.

Mr. Farber notices that no one could really tell when the alarm system is turned off and, if he is careful, he can turn it off and on as necessary to reduce the number of times that the alarm sounds. Mr. Farber feels that it is important to keep the plant operating no matter what. After all, a shut-down will mean heavy losses to the company and force the plant to close permanently. Five hundred jobs will be lost, including Mr. Farber's. He feels that if the people want jobs they will have to tolerate some air pollution.

Should Mr. Farber continue to turn the alarm system on and off until negotiations with the union are completed? Why or why not?

SAMPLE OPINIONS

Pat "Yes, as plant manager, Mr. Farber is expected to keep the plant running. He has to do all he can to produce a product and maximize profits.

I can't imagine what great harm that action can cause since he'll be only doing it for a short time until the strike is over. The workers in the plant are exposed to small amounts of the chemical in the air all the time anyway.

If the strike isn't settled quickly, the plant may have to close and everyone's job will be lost."

Sharon "Mr. Farber has certain responsibilities to the people who work under him. One of the most important is to maintain safe working conditions. His workers trust that he will do all he can to protect their well being. When he turns the alarm off he is betraying their trust. People can't work well together if there is no trust and respect.

Mr. Farber's dishonesty in this case is truly malicious. He has no right to play around with the health of the people in the plant."

Jackie "No, he should not. Turning off the alarm system clearly breaks government regulations. Mr. Farber has no right to go against the rules whenever he feels like it. The rules are set up for a definite purpose and everyone, especially the manager, is expected to abide by them.

Also, the plant will be in even greater trouble if his actions were discovered. Mr. Farber can't risk the possibility of creating another problem for the company, especially at this time."

DISCUSSION QUESTIONS

- From the community's point of view, what are the best reasons for Mr. Farber to keep the plant operating? Why?
- Would Mr. Farber's action be well justified if the strike were settled quickly? Why or why not?
- The constant sounding of the alarm system might frighten the residents living nearby. Since the dangers of vinyl chloride are not altogether clear, is there any reason to alarm the residents? Why or why not?
- Is it ever right to hide the true facts in order not to cause panic among the people? Why or why not? Can you think of any examples?
- Since jobs are so important to the economy of the community, shouldn't the residents be willing to risk some possible side effects? Why or why not?
- The striking plant workers know that the managers lack the skill to control the vinyl chloride from leaking out into the air. If they were thinking about the health of the residents, shouldn't they return to work? Why or why not?
- If people know the health dangers caused by the manufacturing process of certain products, shouldn't they stop using them? Would certain products made from vinyl chloride be difficult for you to give up? Why or why not?
- Should workers (e.g., nurses, policemen, firemen) be allowed to strike for higher wages if their being off the job might affect the health and safety of the community? Why or why not?
- What obligations or responsibilities should manufacturing companies have toward their workers? Community?
- To what extent should society control the way private companies operate? Why?
- If a company discovers that a substance may be harmful, should it wait for government to ban it or should the company discontinue its use? Why?

Strangers In (A Woodland) Paradise

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Reading 1

The Sewerless Society

by Harold Leich

To a visitor from another planet it would seem incredible that human beings who are intelligent enough for space travel solve their problems of personal hygiene by putting their body wastes into the public drinking water and then spend billions in futile efforts to restore the water to its original condition. It is scientifically possible but financially infeasible to restore water completely once it has been contaminated by body wastes.[1]

The flush toilet, long considered the very symbol of modern sanitation and progress, wastes about 40 percent of all water piped into the home and befouls waterways from the muddy Potomac to the blue Mediterranean. Despite the money and energy spent on sewage treatment, traditional disposal methods are at a dead end — more sewers for more people, more billions for more treatment plants, more refined methods of intensive treatment, and still the effluent damages water quality downstream. Adverse effects of present sewage disposal systems include the following:

- *Risk of transmitting diseases to water users downstream.* Chlorination effectively kills bacteria in the drinking water but there is less certainty about killing viruses, which cause diseases such as polio and infectious hepatitis and are suspected as one cause of cancer. Recent findings in the Mississippi River basin indicate that chlorination to kill bacteria from toilets upstream may itself create carcinogenic substances in the drinking water.
- *Waste of large quantities of purified drinking water to carry away small quantities of body wastes.* The average toilet flush uses about five gallons of water. In one year the typical user of a flush toilet contaminates 13,000 gallons of fresh water to carry away 165 gallons of body wastes.

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- *Enormous expenditures for sewer lines and treatment plants.* A recent estimates states that complete sewage treatment for one small river basin — the Potomac — will cost $1.4 billion in addition to the substantial sums already invested in recent decades. But even this huge expenditure will not make the river swimmable. (In 1965 President Johnson, in signing a water quality bill, pledged to reopen the Potomac for swimming by 1975.)

- *Accelerated eutrophication of lakes and estuaries.* Even advanced treatment does not completely remove the dissolved unwanted nutrients from the effluent.

- *Leakage of raw sewage.* Aging sewer lines can allow leakage into the ground water supply or into surface waters. The reverse, ground water leaking into sewer lines, can also happen.

- *Build-up of large amounts of sewage sludge.* The sewage sludge produced at the Blue Plains Plant serving the Washington, D.C., area, for example, is expected to reach 2,400 tons a day when fully operational. Rural residents do not look with favor on receiving the growing waste load.

In an effort to overcome environmental problems caused by the flush toilet, sanitation authorities have deveolped excessively centralized systems — the collection of human wastes from hundreds of thousands and even millions of people into one place for disposal. Such centralized systems are vulnerable to power failures, equipment breakdowns, employee strikes, and by-passing during flooding or high water — all of which can send millions of gallons of raw sewage downstream.

The present situation is bad enough, but what of the future? In 1970 the Council on Environmental Quality estimated that municipal sewage loads would nearly quadruple within 50 years. The Environmental Protection Agency received estimates in 1973 from municipalities for more than $60 billion to build sewage treatment facilities by 1990, but cautioned that the estimates might include inflated costs because 75 percent of the amount would come from Federal funds. Winfield M. Kelly, Jr., of Prince George's County, Md., stated that 1985 sewage-flow estimates for a huge proposed regional treatment plant for that county exceeded the available water supplies for the area by 321 million gallons a day.

Thus it is increasingly apparent that sanitary engineers and public health officials took the wrong turn in the road in the nineteenth century when they encouraged widespread adoption of the flush toilet. The tens of billions now programmed in this country for sewage disposal merely take us further down the same road. Sanitation authorities should also take a hard look at the kitchen garbage grinder, which puts a heavy load of organic wastes into the public water supply. Now is the time to stop this new threat to our rivers, lakes and oceans.

The solution to these water-supply and sanitation problems seems elementary: (1) body wastes should not be put into the public water supply, and (2) sewage disposal systems should be decentralized with wastes disposed of in the individual house, apartment building, or factory. Before the days of 'modern' plumbing, societies had systems for recycling body wastes back to the land — crude, perhaps, but more ecologically sound for the long run than flushing them into the water supply of the next town downstream.

A quiet revolution in sewage disposal is fortunately now taking place in Sweden and the United States. New methods promise to solve the sewage problem by disposing of wastes on or near the site without the use of large quantities of water. They offer us the chance to decentralize human sanitation without going back to the evils of the out-house. If widely adopted they would drastically cut down water consumption and could eventually eliminate costly sanitary sewers and treatment plants.

Waterless toilets were developed several decades ago for owners of homes where water and sewer connections were not available. Because it is now forbidden by law to discharge body wastes into harbors and other confined waters there is a need for sewage disposal systems aboard inland and ocean-going vessels, and several large companies are now investing millions in this field. It is only a step to adapt this new marine technology for use in year-round dwellings and high-rise buildings ashore.

There are at least seven different types of sewerless toilets or sewage disposal systems on the market or under development at this time.

Reading 2

A Primer On Wastewater Treatment

The most common form of pollution control in the United States consists of a system of sewers and waste treatment plants. The sewers collect the waste water from homes, businesses, and many industries and deliver it to the plants for treatment to make it fit for discharge into streams or for reuse.

There are two kinds of sewer systems — combined and separate. Combined sewers carry away both water polluted by human use and water polluted as it drains off homes, streets, or land during a storm.

In a separate system, one system of sewers, usually called sanitary, carries only sewage. Another system of storm sewers takes care of the large volumes of water from rain or melting snow.

Each home has a sewer or pipe which connects to the common or lateral sewer beneath a nearby street. Lateral sewers connect with larger sewers called trunk or main sewers. In a combined sewer system, these trunk or main sewers discharge into a larger sewer called an interceptor. The interceptor is designed to carry several times the dry-weather flow of the system feeding into it.

During dry weather when the sewers are handling only the normal amount of waste water, all of it is carried to the waste treatment plant. During a storm when the amount of water in the sewer system is much greater, it may be necessary to allow part of the water — including varying amounts of raw sewage — to bypass directly into the receiving streams. The rest of the wastes are sent to the treatment plant. If part of the increased load of water were not diverted, the waste treatment plant would be overloaded and the purifying processes would not function properly. (Technology has been developed that will, when applied, control and treat the storm water discharges and the general runoff of rainwater polluted by dirt and other contaminants.)

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Interceptor sewers are also used in sanitary sewer systems as collectors of flow from main sewers and trunks, but do not normally include provisions for bypassing.

A waste treatment works' basic function is to speed up the natural processes by which water purifies itself. In many cases, Nature's treatment process in streams and lakes was adequate before our population and industry grew to their present size.

However, these natural processes, even though accelerated in a waste treatment plant, are not sufficient to remove other contaminants such as disease-causing germs, excessive nutrients such as phosphates and nitrates, and chemicals and trace elements.

When the sewage of previous years was dumped into waterways, the natural process of purification began. First, the sheer volume of clean water in the stream diluted the small amount of wastes. Bacteria and other small organisms in the water consumed the sewage or other organic matter, turning it into new bacterial cells, carbon dioxide, and other products.

But the bacteria normally present in water must have oxygen to do their part in breaking down the sewage. Water acquires this all-important oxygen by absorbing it from the air and from plants that grow in the water itself. These plants use sunlight to turn the carbon dioxide present in water into oxygen.

The life and death of any body of water depend mainly upon its ability to maintain a certain amount of dissolved oxygen. This dissolved oxygen — or DO — is what fish breathe. Without it they suffocate. If only a small amount of sewage is dumped into a stream, fish are not affected and the bacteria can do their work; the stream can quickly restore its oxygen loss from the atmosphere and from plants. Trouble begins when the sewage load is excessive. The sewage will decay and the water will begin to give off odors. If carried to the extreme, the water could lose all of its oxygen, resulting in the death of fish and beneficial plant life.

Since dissolved oxygen is the key element in the life of water, the demands on it are used as a measure in telling how well a sewage treatment plant is working. This measuring device is called biochemical oxygen demand, or BOD. If the effluent or the end-product from a treatment plant has a high content of organic pollutants, the effluent will have a high BOD. In other words, it will demand more oxygen from the water to break down the sewage and consequently will leave the water with less oxygen (and also dirtier).

With the growth of the Nation, the problems of pollution have become more complex. The increased amounts of wastes and the larger demands for water have reduced the capacity of running water to absorb waste water and purify itself. Consequently, cities and industries have had to begin to remove as much as possible of the oxygen-demanding and other pollutants from their sewage.

Adequate treatment of wastes along with providing a sufficient supply of clean water has become a major concern.

Basic Treatment

At present there are two basic stages in the treatment of wastes. They are called primary and secondary. In the primary stage of treatment, solids are allowed to settle and are removed from the water. The secondary stage uses biological processes to purify the waste water even further. In some cases, the two stages may be combined into one basic operation.

Primary Stage

As sewage enters a plant for treatment, it flows through a screen. The screen removes large floating objects such as rags and sticks that may clog pumps and small pipes. The screens vary from coarse to fine — from those with parallel steel or iron bars with openings of about half an inch or more to screens with much smaller openings.

Screens are generally placed in a chamber or channel in an inclined position to the flow of the sewage to make cleaning easier. The debris caught on the upstream surface of the screen can be raked off manually or mechanically.

Some plants use a device known as a comminutor which combines the functions of a screen and a grinder. These devices catch and then cut or shred the heavy solid material. In the process, the pulverized matter remains in the sewage flow to be removed later in a settling tank.

After the sewage has been screened, it passes into what is called a grit chamber where sand, grit, cinders, and small stones are allowed to settle to the bottom. A grit chamber is highly important for cities with combined sewer systems because it will remove the grit or gravel that washes off streets or land during a storm and ends up at treatment plants.

The unwanted grit or gravel from this process is usually disposed of by filling land near a treatment plant.

In some plants, another screen is placed after the grit chamber to remove any further material that might damage equipment or interfere with later processes.

With the screening completed and the grit removed, the sewage still contains dissolved organic and inorganic matter along with suspended solids. The latter consist of minute particles of matter that can be removed from the sewage by treatment in a sedimentation tank.

When the speed of the flow of sewage through one of these tanks is reduced, the suspended solids will gradually sink to the bottom. This mass of solids is called raw sludge.

Various methods have been devised for removing sludge from the tanks.

In older plants, sludge removal was done by hand. After a tank had been in service for several days or weeks, the sewage flow was diverted to another tank. The sludge in the bottom of the out-of-service tank was pushed or flushed with water to a pit near the tank, and then removed, usually by pumping, for further treatment or disposal.

Almost all plants built within the past 30 years have had a mechanical means for removing the sludge from sedimentation tanks. Some plants remove it continuously while others remove it at intervals.

To complete the primary treatment, the effluent from the sedimentation tank is chlorinated before being discharged into a stream or river. Chlorine gas is fed into the water to kill and reduce the number of disease-causing bacteria. Chlorination also helps to reduce objectionable odors.

In the past, 30 percent of the municipalities in the United States did not treat their sewage beyond the primary stage. This amount of treatment alone was inadequate to meet today's water quality requirements. To meet these requirements, cities and industries will have to remove even more contaminants at the secondary stage, and in some cases, use advanced treatment.

Secondary Stage

The secondary stage of treatment removes up to 90 percent of the organic matter in sewage by making use of the bacteria in it. The two principal techniques used in the secondary stage are trickling filters and the activated sludge process.

After the effluent leaves the sedimentation tank in the primary stage of treatment, it flows or is pumped to a facility using one or the other of these processes. A trickling filter is simply a bed of stones from three to six feet deep through which the sewage passes. Bacteria gather and multiply on these stones until they can consume most of the organic matter in the sewage. The cleaner water trickles out through pipes in the bottom of the filter for further treatment.

The sewage is applied to the bed of stones in two principal ways. One method consists of distributing the effluent intermittently through a network of pipes laid on or beneath the surface of the stones.

Attached to these pipes are smaller, vertical pipes which spray the sewage over the stones.

Another much-used method consists of a vertical pipe in the center of the filter connected to rotating horizontal pipes which spray the sewage continuously upon the stones.

From the trickling filter, the sewage flows to another sedimentation tank to remove the bacteria. Chlorination of the effluent completes the secondary stage of basic treatment.

The trend today is toward the use of the activated sludge process instead of trickling filters. This process speeds up the work of the bacteria by bringing air and sludge heavily laden with bacteria into close contact with the sewage.

After the sewage leaves the settling tank in the primary stage, it is pumped into an aeration tank where it is mixed with air and sludge loaded with bacteria and allowed to remain for several hours. During this time, the bacteria break down the organic matter.

The sludge, now activated with additional millions of bacteria and other tiny organisms, can be used again by returning it to an aeration tank for mixing with new sewage and ample amounts of air.

The activated sludge process, like most other techniques, has advantages and limitations. The size of the units necessary for this treatment is small, thereby requiring less land space and the process is free of flies and odors. But it is more costly to operate than the trickling filter, and the activated sludge process sometimes loses its effectiveness when faced with complex industrial wastes.

An adequate supply of oxygen is necessary for the activated sludge process to be effective. Air is mixed with sewage and biologically active sludge in the aeration tanks by three different methods.

The first, mechanical aeration, is accomplished by drawing the sewage from the bottom of the tank and spraying it over the surface, thus causing the sewage to absorb large amounts of oxygen from the atmosphere.

In the second method, large amounts of air under pressure are piped down into the sewage and forced out through openings in the pipe. The third method is a combination of mechanical aeration and the forced air method.

From the aeration tank, the sewage flows to another sedimentation tank to remove the bacteria.

The final step again consists of the addition of chlorine — the most common method of disinfection — to the effluent coming from the trickling filter or activated sludge process.

Chlorine is usually purchased in liquid form, converted to a gas, and injected into the effluent 15 to 30 minutes before the treated water is discharged into a water course. If done properly, chlorination will kill more than 99 percent of the harmful bacteria in an effluent.

Dilemma 11 — STRANGERS IN (A WOODLAND) PARADISE

Wood Gulch was one of the last areas of wilderness in Durango County. A rugged, hilly area with dense woods, it attracted artisans and professionals who wanted to escape the hassles of city and suburban living and to seek a simpler life on the land. These newcomers built their own modest cabins, often experimenting with new and strange building designs, and raised much of their own food.

Because of their different life-styles, surrounding communities and county officials regarded the character of these people as undesirable. The presence of such people, they felt, would affect the image of the entire county and bring down the value of the land.

After the arrival of the new settlers, Durango County developed plans for a regional sewage treatment system. All communities were to use the system and no septic tanks would be allowed. Septic tank users would now have to pay $3,000 to connect their house to the sewer line. Also, they will be paying higher taxes to build the new sewer lines. To the Wood Gulch community this new system was not only too expensive, but it also meant the end of their wooded paradise. Wood Gulch would become another of many suburban subdivisions with terraced land, sidewalks, and manholes installed every 50 yards.

One of the newcomers, a hydraulic engineer and inventor, came up with a new and unique plan for Wood Gulch's own sewage disposal system. Each household would have its own primary treatment unit. The waste water would be treated and then piped down to a central station for final purification. The treated water can then be used for crop irrigation and firefighting. In this way they can conserve water and not add more pollutants to the bay where waste water is emptied.

The Wood Gulch plan was submitted to the Durango County Board of Supervisors and was rejected. The Wood Gulch residents brought the case before the court. Should the judge reverse the decision of the County Supervisors and permit the Wood Gulch residents to use their own sewage disposal system? Why or why not?

SAMPLE OPINIONS

Mark "I don't think that the judge should overturn the decision made by the County Supervisors. After all, how can he go against what the rest of the county wants? The newcomers should conform to the established regulations of the county. If the new system is good enough for the rest of the area, it should be good enough for the newcomers. If the newcomers were there first, wouldn't they expect that anyone else moving in should conform to the codes they establish?"

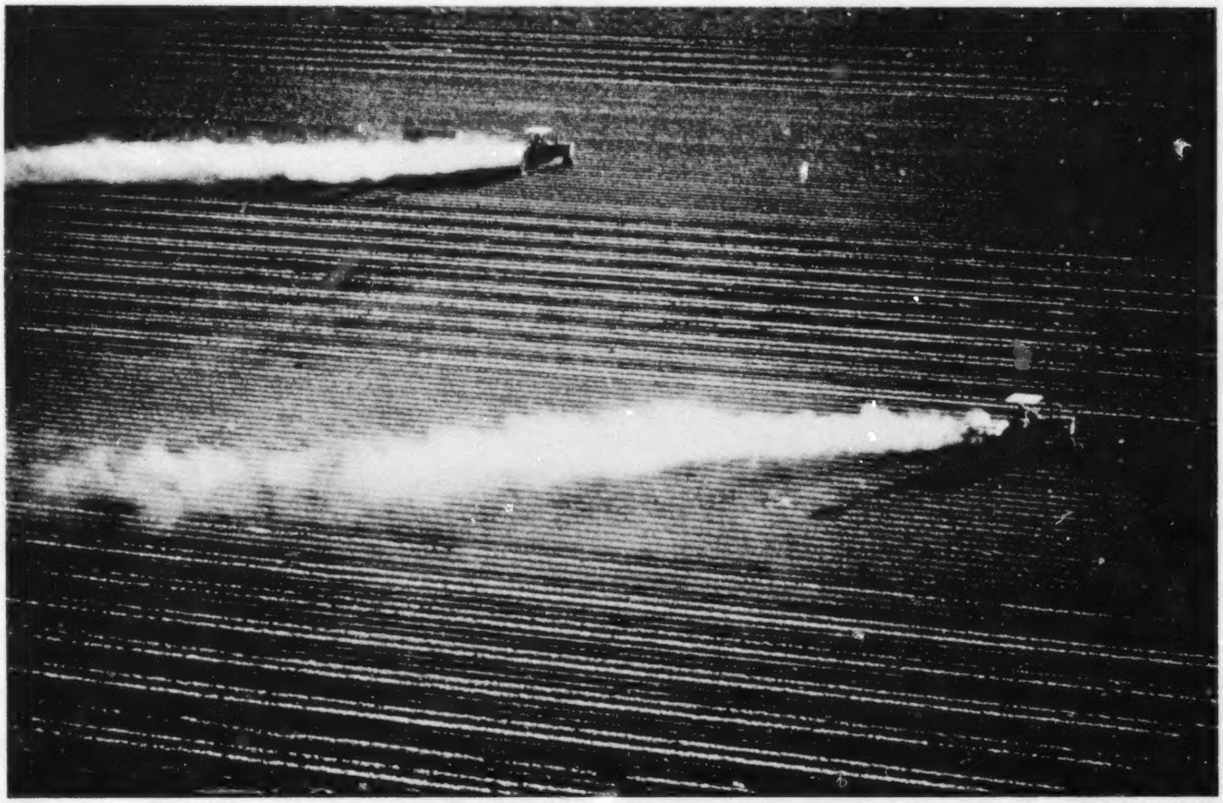
Lynn "The judge should rule in favor of the newcomers. He must consider how the sewer system will affect the lives of the people. Once the sewer system is brought in, it will change the entire character of Wood Gulch. It will become a suburban development instead of natural woods. The sewer system is forcing the people to give up their style of living. People have a right to choose the way they want to live if they don't disturb or injure others. The very reason that the people came to Wood Gulch was to live in a less developed environment. They should have a chance to do so.

Besides, the newcomers' plan will probably, in the long run, have a more beneficial effect on the environment. It might be the best way to recycle waste water. We live in a free country and people should have opportunities to try different technologies, especially one that places less stress on the environment."

Bob "No, the judge should support the position of the County Supervisors. After all, regional plans cannot be effective if all communities do not participate. In this case, the regional sewage system will benefit all who live in the county. The newcomers should have realized that when they moved into the county they would have to share in the responsibility of working together as a total community. Without the newcomers' cooperation, the new sewer system may not be built and everyone else would have to bear the consequences."

DISCUSSION QUESTIONS

- Should the residents of Wood Gulch have the right to determine the type of sewage treatment system they believe is best for their own community? Why or why not?
- In a democratic society, shouldn't people go along with the wishes of the majority even though there might be a better solution to the problem? Why or why not?
- In cases such as public utilities (water, roads, etc.) should everyone have to share in the cost of the system, even if some don't want it? Why or why not?
- If the county officials developed the sewage plan to force the residents of Wood Gulch to change their life-style, are they acting for the good of society? Why or why not?
- Should people be allowed to live a life-style that does not meet the approval of those around them? Why or why not?
- What should be the judge's most important consideration in making his decision? Why?
- The residents of Wood Gulch argue that they do not want to join the sewage plan and further add to the pollution of the Bay. Is this a good enough reason for the judge to reverse the decision? Why or why not?
- The residents of Wood Gulch argue that they do not want to join the sewage plan and further add to the pollution of the Bay. Is this a good enough reason for the judge to reverse the decision? Why or why not?
- If the Wood Gulch community were allowed to develop its new and unique treatment system, how can that change the quality of the environment? Why?



Too Much Of A Good Thing Can Mean Trouble

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Reading 1

On The State of Man[1]

by Philip Handler

World Nutrition

Historically, the bulk of the food eaten by the people of a given nation was raised within that nation's borders. Food supplies and population grew in parallel, by expansion of the areas under cultivation. Until quite recently, worldwide agricultural productivity (i.e., yield per hectare) did not differ greatly among nations. Adequacy of food supply, as understood by Malthus, depended upon the ratio of population to area under cultivation and upon the vicissitudes of the weather. Drought, floods, early rains or freezes, or crop destruction by a virus or insect have periodically rendered food supply inadequate in almost every country, with consequent human tragedy.

Today, predictions abound that more people will starve to death in the 20th century than in any previous century in the history of man. It is estimated that there were about 2 million such deaths in the 17th century, 10 million in the 18th century, and perhaps 25 million in the 19th century. Despite the world's information network, for the remarkable worldwide transportation system and the prolific yields of modern agriculture (where modern agriculture is practiced), available indications suggest that the death toll due to starvation in this century, indeed in the next few years, will set an all-time high. More people may starve to death simply because there are more people.

It is estimated that there are as many as 500 million individuals whose lives today are limited by insufficient dietary calories, protein, and vitamins. As populations grow, the company will surely expand. For them life is a succession of diseases and an apathetic struggle for bare survival.

It is noteworthy that the character of malnutrition has changed in the last 40 to 50 years. Quite apart from occasional acute famines, classic malnutrition was the consequence of some dietary imbalance giving rise to specific deficiency diseases such as beri beri, scurvy, pellagra, xerophthalmia, rickets, sprue, or goiter, due to lack of thiamine, ascorbic acid, nicotinic acid, vitamin A, vitamin D, folic acid, or iodine, respectively. Of these, only xerophthalmia remains as a truly major health problem, causing blindness in thousands of children in the Asiatic tropics, although there remain pockets in which almost each of the classic deficiency diseases may be observed. Instead, the major forms of current malnutrition are iron deficiency anemia, marasmus, and kwashiorkor. The last two diseases, seen in infants and older children respectively, are the consequence of protein insufficiency in individuals who are also deprived of an adequate caloric intake, namely semistarvation.

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[1] This excerpted selection is reprinted by permission from *Bioscience*, Vol. 25, No. 7, July 1975, pp. 425-432.

Whereas the classical forms of malnutrition were in considerable part the consequence of ignorance, malnutrition today generally reflects lack of food rather than lack of scientific understanding. Unfortunately, these same populations are afflicted with a host of infectious and parasitic diseases to which they are made more susceptible by their malnutrition and which, in turn, frequently deprive them of the nutritional benefit of such food as they may ingest. The reported death rates for malaria, schistosomiasis, hookworm, filariasis, bilharzia, and the like conceal much of the death rate caused by chronic malnutrition.

Food Production

Worldwide primary food production, now about 1,200 million metric tons of cereal grain annually, has continued to grow more rapidly than has the total human population, roughly 2.5% per year as compared with 2%. But the great increases in production have not occurred where populations are growing most rapidly. The great gains in cereal production have occurred where modern energy-intensive agriculture has combined irrigation, pesticides, herbicides, fertilizer, applied genetics, and mechanization to the increase of yields. In effect, modern agriculture utilizes sunlight to transmute fossil fuels into edible crops. Yields per hectare on an Iowa farm can be more than six times what they are generally in Pakistan or India, for example. Total land under cultivation in India is about 85% of that in the United States. But total crop yield is less than 40% of that of the United States, whereas the Indian population is 2.75 times the American population.

This great disparity in productivity has developed largely during the last four decades and will serve to contrast agriculture in the developed and developing countries generally. The technical basis for this difference in agricultural productivity will be evident from the fact that, whereas application of mixed fertilizer (N, P, K) in the countries of western Europe frequently exceeds 200 kilograms per hectare and in the United States averages about 100 kilograms per hectare, for developing countries fertilizer usage still averages less than 25 kilograms per hectare. In a general way, one metric ton of fertilizer applied to unfertilized land yields an additional 10 to 20 metric tons of grain, enough food for 50 to 100 people for one year.

As a result of continuing population growth, there has been intense pressure on the agriculture of most countries of the world. Meanwhile, the flourishing agriculture of the United States and Canada, and to a lesser degree Australia and New Zealand, has made them the breadbasket of the world. North America exports grains equivalent to about 8% of annual world production. The United States is also the unique exporter of soybeans in quantity. At the same time, as the American appetite for animal protein has increased, we have come to feed so much grain to poultry and livestock that each of us now lives on approximately 10,000 primary agricultural Calories per day. Nevertheless, so great is our agricultural productivity that last year we exported two-thirds of the wheat crop, half of the soybean crop, and two-fifths of the corn crop, for a total exceeding $21 billion at last year's inflated prices, a return far exceeding that from either of our major exports of "high technology" — computers and jet aircraft.

Outside our borders, other nations with growing economies but without an equivalent agriculture have also increasingly developed their appetites for animal protein. Hence, 60% of North American agricultural sales has been to nations whose people are already rather well fed. Except for the great Soviet wheat purchase, our affluent customers largely seek coarse grains and soybeans for their livestock, whereas the developing nations seek wheat, rice, and soybeans for their peoples. At this time, the approximately one billion people of the developed world feed enough grain to their livestock and poultry to provide the minimal nutritional sustenance of another two billion people. The result is that, while world population has been growing at 2% and agricultural production at 2.5%, world demand for agricultural production has been growing at 3% per year. That differential represents an ever-growing number of hungry mouths and is aggravated by the disproportional consumption patterns of affluent individuals within developing nations. But it is also clear that, were international distribution systems available and were there the political will, total agricultural production is such that no one need starve anywhere in the world at this time.

With the rest of the world barely able to sustain itself, the accumulated grains in storage in the United States plus the 20 million hectares held out of production in the soil bank constituted the principal food reserve of the planet, about 95 days worth in 1961. The poor crops of 1967 and 1972, together with the large Russian wheat purchase and the belated reopening of American reserve lands, resulted in a decline of this reserve to less than a 30-day supply as we entered the winter of 1974-1975. But 1974 witnessed another worldwide crop shortfall due to adverse climatic conditions in various countries, including the United States. That crop was 45 million tons less than had been projected, of which the Indian shortfall alone was about 8 million metric tons. For lack of reserves, consumption this year must be almost entirely from this year's insufficient production. The result is acute famine in a number of countries, most notably on the Indian subcontinent, with the prospect of hundreds of thousands of deaths from starvation. Current inadequate reports indicate a toll of more than 10,000 such deaths per week.

Under these circumstances, and in the absence of a carefully thought through and accepted national policy, I consider that the American tradition imposes upon us the moral obligation to respond to this emergency by the only means available, namely, providing grants and concessional sale of grains and soybeans from our dwindling reserves and from last year's crop — a gift from the American taxpayer. But such an action should not be mistaken for long-term policy. As we shall see, that must be dictated by more complex considerations.

In India, the "Green Revolution" was making significant progress. But Indian-irrigated agriculture is made possible by more than two million diesel-powered pumps requiring imported oil and by importation of 40, 60, and 100% of its nitrogen, phosphate, and potash fertilizers, respectively. The absolute amounts of imported fertilizer would have been far greater in recent times had the purchasing power been available. The effects of adverse climate in 1974 were compounded by inadequate supplies of oil and of N-fertilizer as the prices of both increased startingly. Since the price of wheat and rice on the world market rose spectacularly at the same time, India was unable to purchase American grain, and her population suffered. It is of interest that the manufacture of nitrogen fertilizer (as ammonia or urea) requires natural gas, refining gas, or naphtha for this synthesis. Whether the fertilizer was made at home or in Japan, these raw materials were obtained from the Persion Gulf area in an amount sufficient to make 1.8 million tons of fertilizer used in India and Pakistan last year. Since fertilizer in this quantity suffices to permit an additional yield of 18 to 20 million metric tons of rice, the Indian subcontinent is as dependent on the Middle East for its food supply as it is upon the United States, where agriculture also depends upon imported petroleum. Withal, serious as is the food crisis of the moment, perhaps a larger danger arises out of the loss of momentum in food, population, and economic development in the affected nations, which will have great difficulty in regaining their strides.

Reading 2

The Land — Its Future-Endangering Pollutants

by David E. Elrick

Pollution By Fertilizers

As an agriculturist, it is difficult for this author to think of fertilizers as pollutants. However, when nutrient elements, such as phosphorus and nitrogen, are present in water supplies they can promote the growth of algae and aquatic plants. Also, in some cases, certain nitrogen compounds can act like poisons.

Although the presence of these nutrients in water supplies is normal because of leaching and run-off processes, sufficiently high concentrations of these nutrients in water supplies can lead to accelerated eutrophication. How much of the fertilizer applied to agricultural land reaches surface water supplies? To answer this question, it is necessary to have an understanding of the reactions that fertilizers undergo in the soil and the more important transport mechanisms.

Phosphorus compounds in fertilizers react very quickly with iron, aluminum and calcium compounds in the soil to form new compounds which are only slightly soluble in water. On the other hand, the nitrogen compounds in fertilizers react quite differently. Under normal conditons, they are oxidized to the nitrate form; nitrates are soluble and mobile and free to move in association with the movement of soil water. Much of the fertilizer nitrogen is in the ammonium form which can be converted in the soil within several weeks by microbial action to the nitrate form. There are two important factors controlling the nitrate nitrogen level in soils: the rate and the time of application. Fortunately, pollution control and efficient farm management go hand-in-hand. Fertilizers must be purchased and it is to the farmer's advantage to get the maximum benefit from a minimum application. If rates higher than those recommended by the competent authorities are exceeded, it is possible that there may be some leaching of nitrogen into ground-water supplies.

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[1] This excerpted selection is reprinted from *Impact Of Science On Society*, Vol. XIX, No. 2, 1969. © Unesco 1969. Used by permission.

Both nitrogen and phosphorus compounds may be directly transported to surface water supplies by soil erosion and surface run-off. It is also the benefit of both the farmer and the conservationist to minimize this erosion process.

At present there is considerable controversy over the effects of nitrates in water supplies and food products on both animals and man. Drinking water tolerances have been set by most authorities at about 10 ppm of nitrogen in the nitrate form (a relatively low concentration).

As explained previously, nitrate nitrogen can build up to significant levels under certain conditions, particularly in ground-water supplies. In addition, the application of nitrogen fertilizers will usually increase the nitrogen content in the plants. Under certain exceptional circumstances a high nitrate intake can cause health problems. In infants and young animals, the nitrate ion can be reduced to nitrite by organisms in the stomach. (Apparently this does not occur in humans after about 6 months of age.) If the nitrite is absorbed into the bloodstream, it can cause a shortage of oxygen, a condition commonly referred to as 'blue baby' (methaemoglobinaemia). In extreme instances, death has resulted.

Care should certainly be taken with soils used to produce crops for baby foods.

Dilemma 12 — TOO MUCH OF A GOOD THING CAN MEAN TROUBLE

Daniel Nester is the president of the small, sparsely populated coastal country of Baria. Until recently Baria's major industry has been fishing. Fifteen years ago a major oil field was discovered in Baria. Because of this discovery, the standard of living in Baria has risen from near poverty to affluence.

Adjoining Baria is the country of Yemal. For centuries Yemal has suffered from overpopulation, disease, and famine. In order to increase its farm production, Yemal has adopted several modern agricultural techniques: small, independent farms have given way to large cooperative farms; new strains of "miracle" wheat are planted; new irrigation canals are built; and a huge dam has been constructed on its main river to store water and to generate electricity. Most importantly, however, large amounts of pesticides and nitrogen fertilizers are used. Even with all of these efforts, Yemal continues to experience difficulties feeding its ever-expanding population.

The damming of the river and the use of great quantities of nitrogen fertilizers and pesticides by Yemal are beginning to seriously threaten the quality of Baria's environment. Damming of the river has reduced the water flow into Baria and changed the river to a point where fish spawning areas have been damaged. The use of large amounts of pesticides and nitrogen fertilizers has drastically reduced the number of fish and shellfish that make up a large part of the diet in Baria. Even Baria's drinking water is being contaminated to a serious level.

President Nester of Baria is greatly concerned for his people. He has met with leaders of Yemal numerous times, but no acceptable agreement has been reached.

President Nester feels that the time has come to take drastic action. He is considering an embargo on all fertilizer and pesticide shipments to Yemal. Since Yemal has no ports of its own and must bring all supplies through Baria, an embargo can be easily achieved. In addition, President Nester plans to use his power as a major oil supplier. He will refuse to ship oil to any country that continues to supply Yemal with fertilizers or pesticides.

Should President Nester take these actions? Why or why not?

SAMPLE OPINIONS

Carol "President Nester would be very foolish to take such action. Surely, any attempt to enforce the embargo and in essence starve out the people of Yemal would raise the wrath of all nations of the world. No country with any sense of decency would go along with such a boycott that could cause massive starvation. How can anyone be so cruel to attempt to deny a country its right to grow food?"

Nathan "Yes, President Nester should impose the embargo on Yemal. As the leader of his country he is obligated to place the interests and needs of his people above all else. In other words, his most important obligation is the welfare and safety of his people and to protect their right to a decent existence."

Leo "President Nester should not take such a drastic action against the people of Yemal. Just because he is president of a rather powerful country does not give him the right to force others to change their ways of producing food. In this case, Nester is dealing with a life and death situation. Certainly, he has no right to deliberately attempt to starve out thousands of people who are less fortunate. He has to find a more reasonable solution to the problem. Countries can't exist peacefully when problems are settled through threat and force. The lives of too many people are involved. This must be the first consideration."

DISCUSSION QUESTIONS

- Should a leader of a country, such as President Nester, be expected to protect the welfare of his/her people at all costs? Why or why not?
- If Yemal experiences a devastating famine and thousands die, should President Nester be held responsible? Why or why not?
- Since the activities in Yemal have an adverse effect on the people of Baria, shouldn't Baria do what it can to protect itself? Why or why not?
- Should a country carry out activities (such as using large amounts of fertilizer and pesticides) that are detrimental to its neighbors even if such activities are necessary for the survival of its people? Why or why not?
- If Mexico complained that the United States' use of pesticides and fertilizers was affecting the health of Mexicans, should the U.S. stop using them immediately? Why or why not? What effects might we experience if we were to discontinue the use of nitrogen fertilizers? Pesticides?
- Do the people of Baria have a right to enjoy a good life by preventing Yemal from using nitrogen fertilizers to grow crops?
- Should the countries supplying the fertilizer to Yemal comply with President Nester's order? Why or why not?
- Since Baria is so well off, shouldn't it offer aid to Yemal to overcome starvation and poverty? Why or why not?
- What obligations do countries in the world have for one another? Why?

STUDENT ACTIVITY

Guidelines for Environmental Policy or A Code of Environmental Ethics

In the preceding dilemma discussions you encountered a number of environmental conflicts brought about by new advances in science and technology. In some cases, these situations have caused much public discord because society has not had previous experience in dealing with them. One reason is because there are no widely agreed upon standards or regulations to guide the activity. As a result, many cases have had to be settled by the courts because the laws do not clearly cover the new situation or else the law is antiquated. In other cases, the issues are highly complex and cannot be resolved simply because so many different interrelated factors are involved. One solution might possibly cause undesirable consequences in another area.

For example, advances in chemistry has led to the creation of thousands of new man-made compounds, many of which have become a common part of our every day living. However, in manufacturing such products waste materials are produced and are disposed. Until recently the toxic effects have not been recognized. Later, people living on land previously used as disposal sites began suffering from serious diseases. Meanwhile the chemical company has closed its operations and sold all its property. The question of who cleans up the dangerous wastes and who compensates the victims looms to the forefront. Who should bear the responsibility? Can the burden of responsibility be placed on the company if it had no knowledge of the future consequences of its dumping activities? If the company no longer exists who can be held responsible?

In this activity you will have the opportunity to offer some of your ideas by developing a set of environmental policy guidelines or a code of environmental ethics to govern activity at the government, industry or personal level. Some of the many possible topics are listed below. However, there may be other topics you may wish to consider, so feel free to add to your own.

- A Personal Environmental Action Guide
- Ethics Toward the Natural Environment
- A Bill of Rights for Animals
- Controlling Chemical Pollutants in Air or Water
- Allocation of Scarce Resources (energy, gasoline, water, etc.)
- Disposal of Toxic Wastes (chemicals, radioactive materials, etc.)
- Ownership of Beaches or Lakes
- Food for Famine-Stricken Countries
- Industrial Safety
- Development of Land

The guidelines may be written from a variety of perspectives such as from the perspective of a government agency (Forest Service, Department of Health and Welfare, Department of Transportation, etc.), community boards, (planning, housing, waterworks), industry (management, unions, etc.), citizen groups (Sierra Club, Audubon Society, etc.) or an organization of scientists.

The guidelines need not be elaborate and can simply be a series of short statements. However, they should indicate that you have given some thought to the topic and considered how the guidelines affect the welfare of individuals, society at large and the environment. Will your guidelines protect the rights of the individual as well as the general public? Will your guidelines treat everyone fairly?

The guidelines may be written as an individual assignment or as a group assignment. If the guidelines are to be written as a group, each group member may wish to select one specific section to develop. In developing guidelines as a group, it is important to first discuss the topic thoroughly, highlight the problems in the area, and come to some general consensus about your major concerns.

The example and questions below provides some ideas on how to precede.

Policy Guidelines for Emergency Water Conservation in My Community

(e.g., The water supply is down by 40% and measures must be taken to conserve water.)

Possible ideas for consideration:

1. *Who cuts back?*
   Where can the greatest cutbacks be made? (e.g., homes, businesses, industry, farms, recreation, hospitals, schools, etc.) What group uses the largest amount of water? What group can best afford to reduce consumption? Is there a category where large cutbacks cannot be made?

2. *Equalizing the sacrifice*
   What is the fairest way to determine the water allotment? (e.g., If households are asked to cut back by 40%, is the person who previously used large quantities of water, such as taking 30-minute showers or watering the lawn daily, giving up as much as someone who uses very little water?)

   Should a uniform set allotment be imposed on everyone? Are there some people who have greater need for water? (Will those who can afford it, simply go out to eat and not use the water for cooking and dishwashing? Or go to their private club to shower? Or buy bottled water brought in from elsewhere?)

3. *Decision-Maker*
   Who should make the decision on the amount of cutback for each category of users? Public vote? (What group is in the majority — businesses? Industry? Homeowners? Whose interest would be advanced?) The mayor? (What if he is the owner of a large paper mill in town?) The Water Company? (Will its large customers be favored?)

4. *Regulating the rationing*
   Should the cutback be voluntary or strictly monitored? How will offenders be disciplined? By fines, imprisonment? (If fines are imposed, will the rich really be affected?)

   Who will be responsible for regulating the cutback?

5. *Effects*
   Will individual privacy be jeopardized if someone is monitoring how people use water? Will some people be unfairly penalized? (e.g., car-wash or laundry businesses)

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GLOSSARY

ACQUIESCENCE (*n*) — a quiet agreeing or silent submission.

AESTHETICS — related to or dealing with beauty or showing good taste.

AGAR (*n*) — a gelatinous material extracted from algae, used for bacterial cultures and gelling foods.

ALGAE (*n*) — a group of plants, one-celled, colonial, or many celled, containing chlorophyll and having no true root, stem or leaf; found in water or damp places. Includes seaweed, pond scum, etc.

AMORTIZATION — the act of gradually reducing; such as in reducing a mortgage by continuous, periodic payments.

ANATHEMA (*n*) — a curse; something greatly detested.

ANEMIA (*n*) — a condition where blood is deficient in red blood cells, hemoglobin or total volume; lack of vitality.

ANOPHELINE (*adj or n*) — a genus of mosquitoes which can carry the malaria parasite and transmit the disease.

AQUEDUCT (*n*) — a giant size pipe conduit, for conveying large quantities of water, usually over long distances.

AQUIFER (*n*) — a porous water-holding rock, sand or gravel formation.

ARDUOUS (*adj*) — very difficult or hard to accomplish.

ASBESTOS (*n*) — a grayish mineral, a silicate of calcium and magnesium. It is used for fireproofing material for buildings and safes, and for firemen's clothing because it is incombustible.

AWASH — alternately exposed and covered by tide or wave; flooded.

BASTION (*n*) — the projecting part of a fortification; a fortified area or position.

BEFOULS — to make foul or soil

BERYLLIUM (*n*) — a hard, rare metallic chemical element used in hardening alloys.

BILHARZIA (*n*) — a disease caused by parasitic worms; these worms lodge in the veins of the human body, especially the bladder and the mesentery (membranes).

BIODEGRADABLE (*adj*) — capable of being broken down by the action of living organisms. Microorganisms play an important role in biodegradation.

BRINE (*n*) — water containing much salt; any heavily saturated salt solution.

CAPILLARY (*n*) — any of the minute vessels which connect the terminal arteries and veins; a long, slender tube with a narrow bore.

CARCINOGEN (*n*) — a substance that produces cancer.

CARDIAC (*adj*) — dealing with or pertaining to the heart.

CARNIVOROUS — feeding or subsisting on animal tissue; meat-eating.

CARRAGEEN (*n*) — a purplish, edible seaweed found along rocky coasts; used as a thickening agent in foods such as ice cream.

CATARACTS (*n*) — a clouding of the lens of the eye, resulting in partial or total blindness.

CAVERNOUS (*n*) — something very hollow or deep; cave-like.

CHLORINATE (*vt*) — to treat or combine with chlorine (a greenish-yellow, gaseous chemical element used as a bleach or disinfectant in water purification).

CLERESTORY (*n*) — an outside wall of a building or room that rises above an adjoining roof and contains windows.

CONCESSIONAL (*adj*) — refers to the granting or conceding of an activity or property.

CONSORTIUM (*n*) — a partnership or agreement.

DIAMETRIC — directly opposed, contrary.

ECOSYSTEM — the community of organisms (plant and animals) and their environment which functions as an interrelated unit.

EFFLUENT (*n*) — something that flows out or forth; the outflow of a sewer, sewage tank.

EGALITARIANISM (*n*) — the belief that all men should have equal political and social rights.

ELAN (*n*) — enthusiasm; vigor.

ENTITLEMENT (*n*) —the right or proper designation to a claim or benefits.

ENTOMOLOGIST (*n*) — one who collects and studies insects.

ENUNCIATE (*vb*) — to announce, proclaim.

ENZYME (*n*) — any of numerous complex protein produced in plant and animal cells which catalyze specific biochemical reactions.

ESTROGEN (*n*) — a female sex hormone.

ESTUARIES, ESTUARY (*n*) — the broad mouth of a river into which the tide flows, or an inlet of the sea.

EUTROPHICATION (*n*) — the natural or artificial enrichment in water supplies of nutrients that supplement the growth of plant and animal life; often refers to the aging of a body of water because of increased amounts of organic material.

FEEDSTOCK (*n*) — a raw material supplied to a machine or processing plant.

FILARIASIS (*n*) — a disease condition caused by filarial worms which are transmitted by mosquitoes and invade lymphatic vessels and lymphoid tissue.

GEOTHERMAL (*adj*) — relating to the internal heat of the earth.

GUARANTOR (*n*) — one that makes or gives a guaranty.

HERBIVORE (*n*) — an animal which subsists on grass or other plants.

HERBIVOROUS — see *herbivore*.

HOOKWORM (*n*) — any group of parasitic worms which causes disease in the small intestine; the larvae enter the body through the skin of the feet or are ingested via contaminated food or drinking water.

HYDROCARBON (*n*) — any compound containing only hydrogen and carbon: benzene and methane are hydrocarbons.

HYDROLOGIST (*n*) — an expert in hydrology (the study of water), especially the study of underground sources.

INADVERTENT MODIFICATION (*n*) — the careless or negligent changing of something. An example of inadvertent modification is the change in the ozone layer of the atmosphere caused by freon released from aerosol spray cans.

INNOCUOUS (*adj*) — harmless, producing no ill effect.

INSIDIOUS — moving in a slow, not easily apparent manner; more dangerous than seems evident.

INTERTIDAL (*adj*) —referring to the coastal zone above the low-tide mark.

INUNDATING — to fill with an overflow; abundance.

JUGGERNAUT (*n*) — a massive, relentless force or object which crushes whatever is in its path.

KILOVOLT — equal to one thousand volts. Kilo = 1,000 volts.

LEACHATE (*n*) — a solution or substance that is obtained after a liquid passes through a porous material, such as the materials picked up by water after it passes through a refuse dump.

LICHEN (*n*) — a cellular plant without a stem or leaves and consisting of an algae and a fungi growing in interdependent association.

LITIGATION (*n*) — a lawsuit; a dispute to be settled by judicial process.

LYMPHOCYTE (*n*) — a variety of colorless corpuscles formed in the tissue of the lymph glands and passed from the lymph into the blood.

MALAISE (*n*) — a vague feeling of physical discomfort or uneasiness.

MALTHUS — the English writer, Thomas R. Malthus (1766-1834); his theory states that the increase in population is greater than the increase in the means to provide for it, and that unless population is controlled, disease, famine or war serve as a natural restriction of the increase.

MENHADEN (*n*) — a marine fish common along the east coast of the United States, used for making oil and fertilizer.

METABOLISM (*n*) — the sum of chemical processes which take place within an organism or cell to provide energy and to repair or replace cellular components. Protoplasm in a cell is continually being broken down and built up.

METABOLIZED — see *metabolism*.

METEROLOGICAL — pertaining to the atmosphere and its phenomena of weather or climate.

MICROWAVE — an extremely short electro-magnetic wave.

MINUSCULE — very small or tiny.

MODULE — a particular model or pattern which is constructed on a small scale.

MUTAGENIC (*adj*) — capable of bringing about mutations. See *mutation*.

MUTATION (*n*) — a significant change or alteration of the genetic material of an organism.

NAPHTHA (*n*) — any of several inflammable, volatile liquids produced by the distillation of coal tar, wood coal and other carbonaceous materials.

NEUROLOGY — dealing with or pertaining to the nervous system.

OMINOUS (*adj*) — exhibiting an evil or threatening sign or omen.

ORGANIC (*adj*) — related to or derived from living organisms; containing carbon compounds.

OVIDUCT (*n*) — a duct or tube through which the egg passes from ovary to uterus or to the outside.

OXIDIZE (*vb*) — to combine with oxygen; to remove one or more electrons from an atom, ion or molecule thus changing it from a lower to a higher positive valence.

PANACEA — a remedy which is a cure-all for a problem.

PARAFFIN — a white, waxy, solid substance consisting of a mixture of hydrocarbons. It is obtained chiefly from distillation of petroleum.

PARLANCE — a particular style or manner of speaking, a formal debate or discussion.

PATHOGENIC (*adj*) — causing or capable of causing a disease.

PHOTOVOLTAIC (*adj*) — related to or using the electromotive force when light energy falls between two different substances in close contact.

PLANKTON (*n*) — microscopic animals and plants that float or drift in water, especially at or near the surface, used as food by larger aquatic animals.

PROFLIGATE (*n*) — one who is extremely wasteful; recklessly extravagant.

PROLIFERATION — the reproduction or growth by the multiplication of new systems or parts.

PROLIFIC (*adj*) — producing many young or much fruit; abundant growth.

PLUTONIUM — a radioactive chemical element obtained by bombarding uranium with neutrons.

REPRECIPITATE (*n*) — a substance which is separated from a solution or suspension by a chemical or physical process.

RESIDUAL (*n*) — what is left at the end of a process; the remainder.

SALINITY (*n*) — a concentration of metallic salt(s) in solution; saltiness.

SAND LAUNCE (*n*) — a group of small marine fish with pointed snout and a long, slender body; also known as a sand eel.

SCHISTOSOMIASIS (*n*) — a disease caused by any of a group of flukes that live as parasites in the blood of mammals and birds and affecting the intestines, liver and spleen.

SLAKE (*vb*) — to satisfy or quench (thirst).

SOLIDIFY — to make solid, or compact.

SYNTHETIC (*n*) — something produced by man-made synthesis rather than of natural origin.

THERMAL (*adj*) — related to or caused by heat; designed to prevent loss of heat.

VICISSITUDE (*n*) — change occurring in the course of an event; a chance fluctuation.